WATER WORKS & SEWERAGE

A GILLETTE ABP ABC PUBLICATION

EDITOR

MARCH, 1938
VOLUME 85, No. 3

IN NIAGARA FALLS, New York

While hundreds of thousands witnessed the destruction of the World famous Niagara Falls View Bridge by an ice pack that reached heights of 90 feet, millions of others throughout the Nation anxiously awaited news with the hope that the bridge might be saved. There was a vivid picture in the minds of all who had seen this engineering masterpiece that connected two Nations and was affectionately known as "Honeymoon Bridge."

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David Mann, Superintendent, Department of Public Service, Niagara Falls, N. Y.

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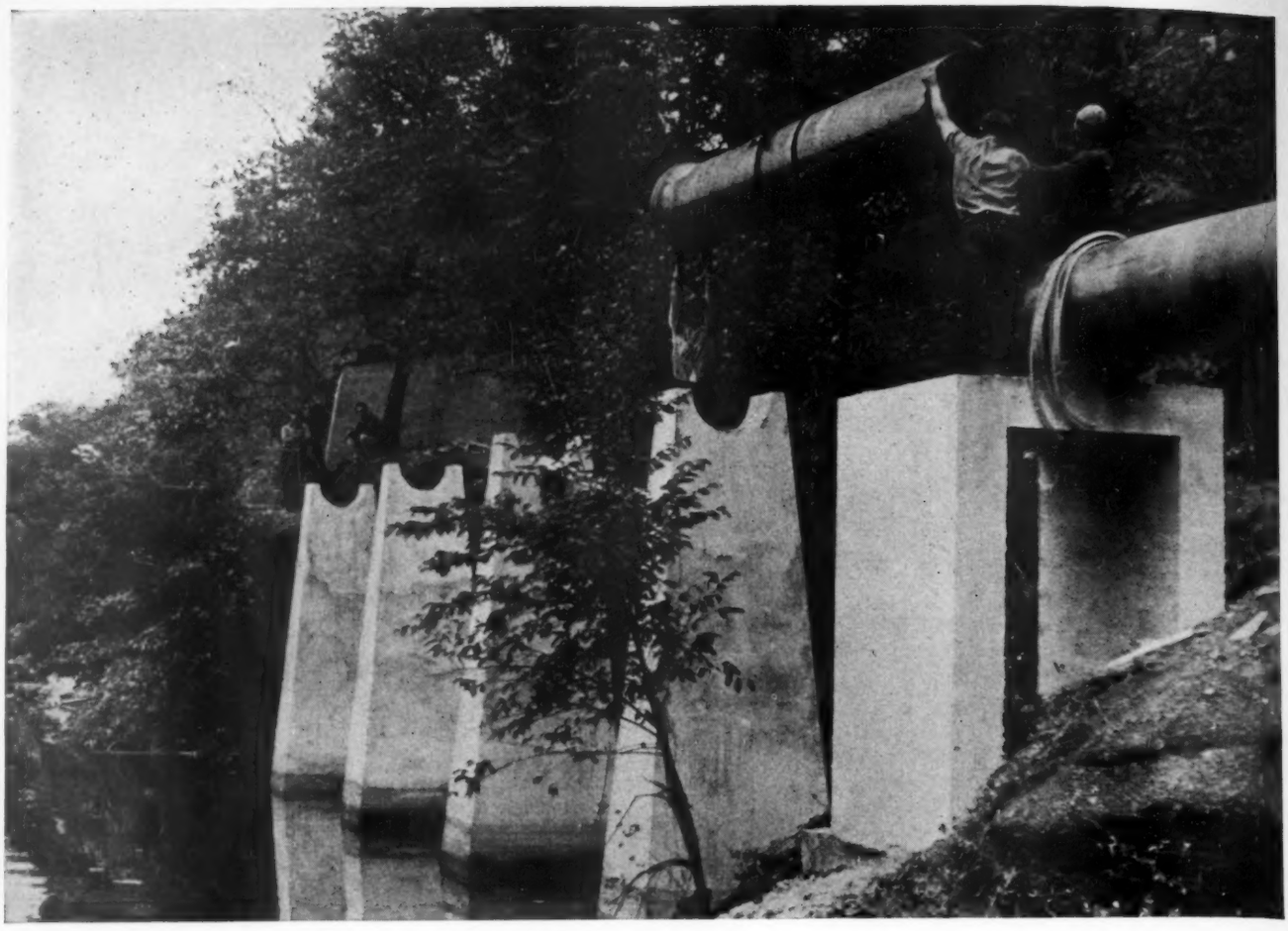

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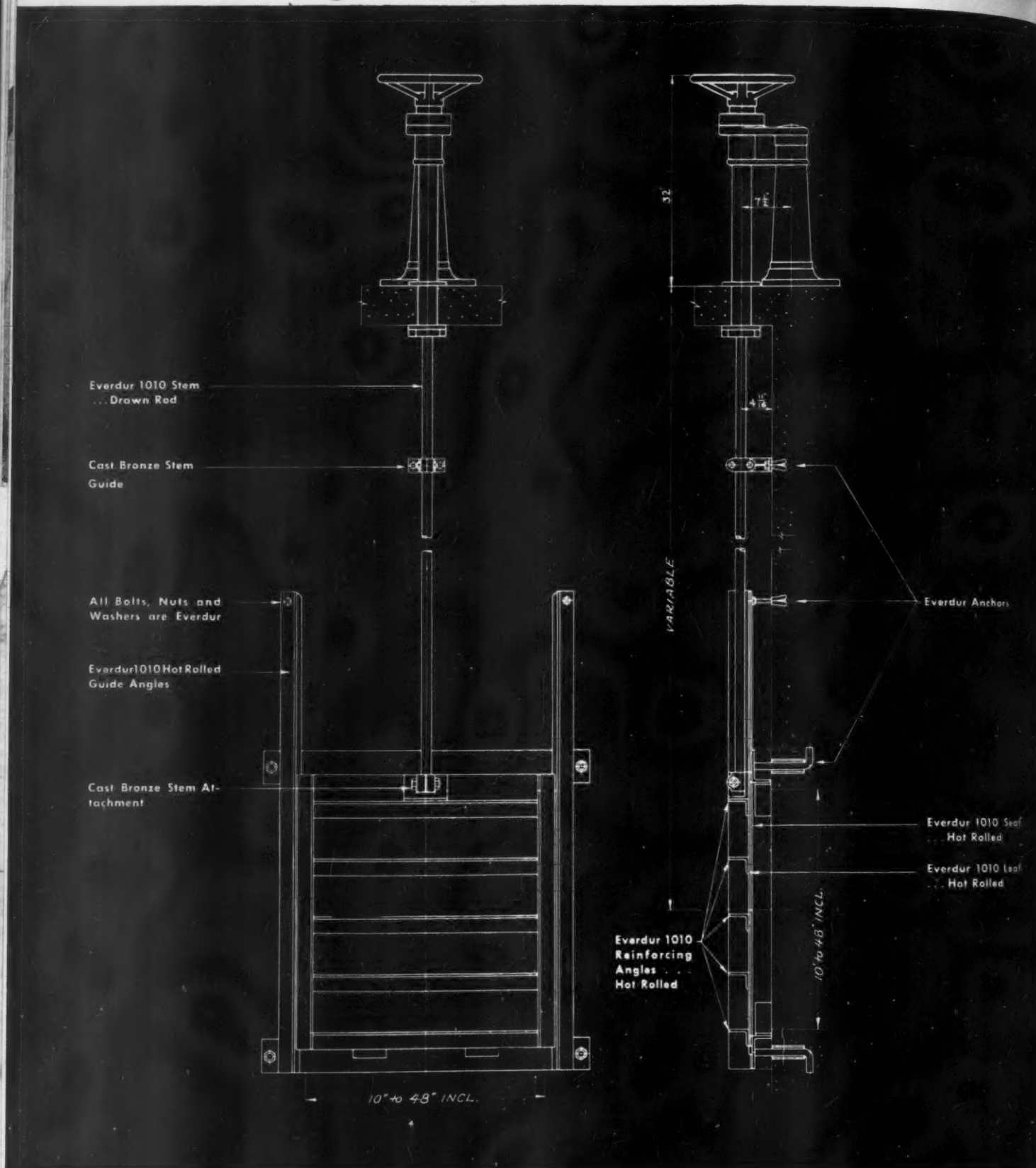
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• • •

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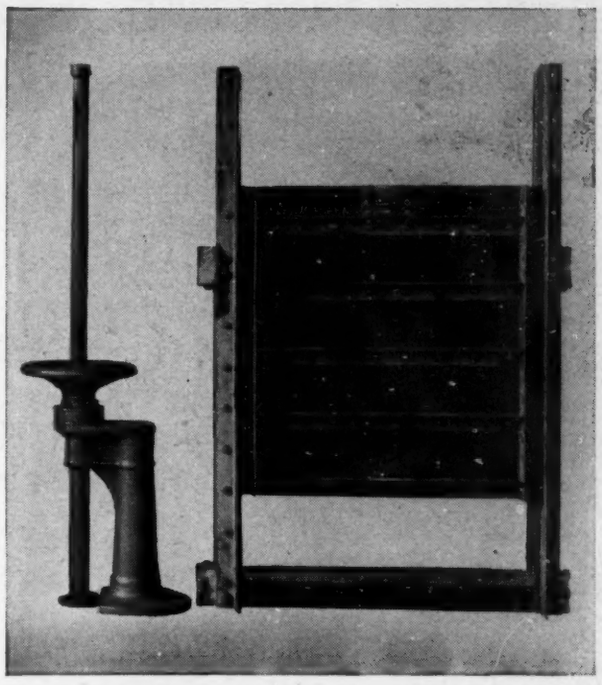

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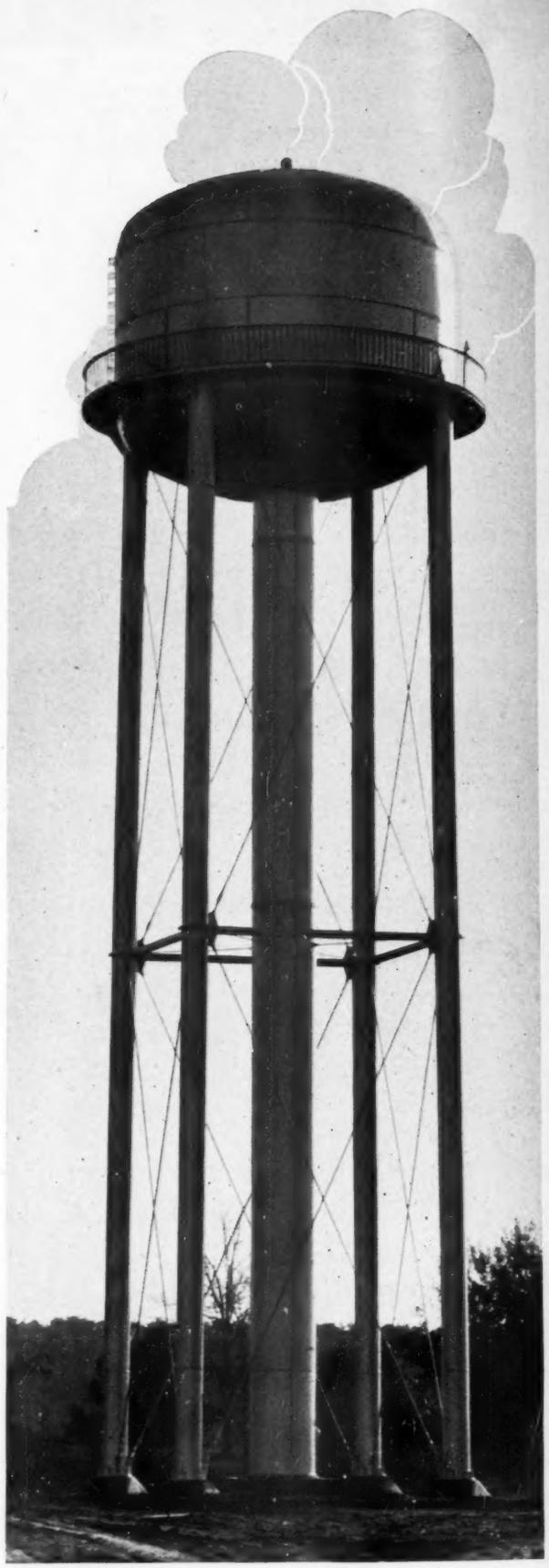

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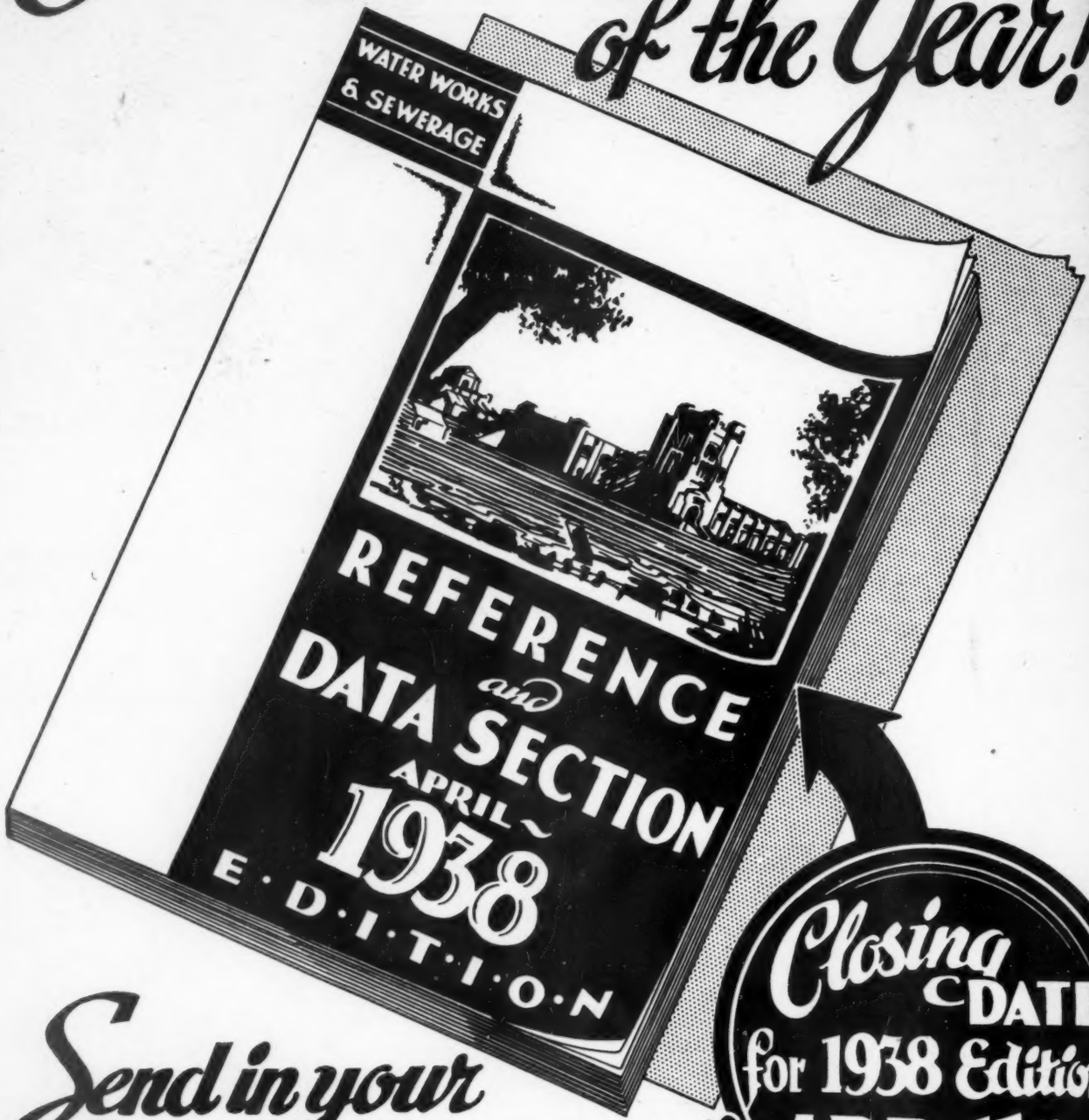

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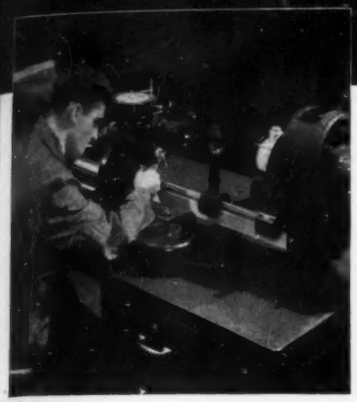

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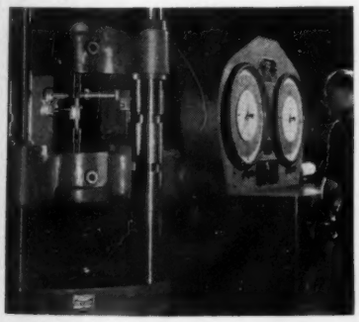

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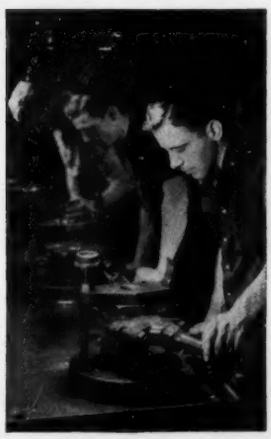

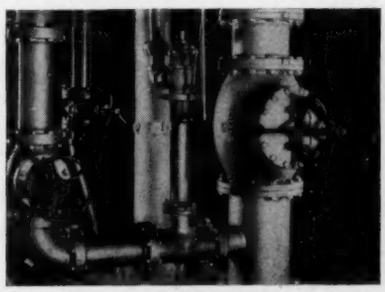

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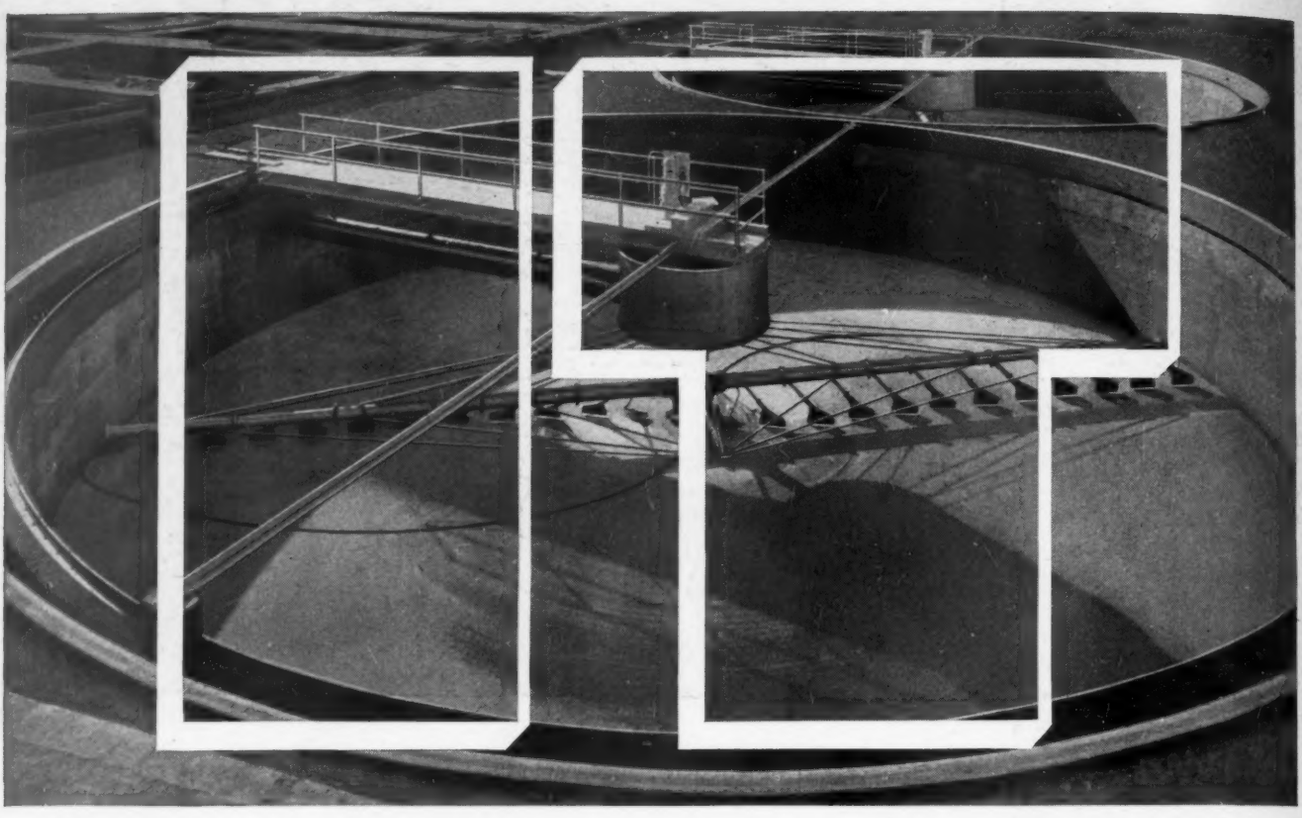

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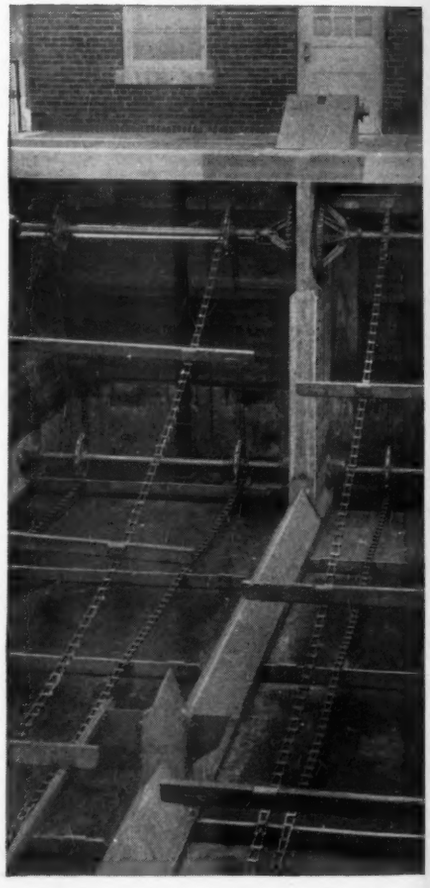

Which to use will depend to a certain degree upon the type of plant. The conveyor type can easily be installed in existing square or rectangular tanks, as well as new—the Tow-Bro in existing round, square or rectangular tanks.

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WATER WORKS & SEWERAGE

E. S. GILLETTE, Publisher

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ARTICLES AND AUTHORS Scheduled for Future Issues

"Sewer Maintenance"—is the topic to be discussed by one of America's outstanding sewerage superintendents—John H. Brooks, Jr., Supt. of the Worcester, Mass. Sewer Department. Well known to New Englanders, the author enjoys the distinction of being President of the New England Sewage Works Assn. Mr. Brooks has served Worcester long and efficiently —first as engineer of sewer construction and since as manager of Worcester's Sewerage System and Sewage Treatment Plant. His paper on "Maintenance of Sewers" will contain comments on design, operation and management in addition to maintenance practices. In consideration of the author's experience in sewerage engineering, his contribution is expected to prove an especially valuable one.

"Limestone Contact Beds for Corrosion Control"—by I. M. Glace, Consulting Engineer of Harrisburg, Pa., holds much of interest to engineers, managers and chemists confronted with the problem of effective, practical and economical control of corrosion on small and moderate sized water supply systems. In an earlier article (Water Works & Sewerage of January 1937) Mr. Glace reported on barrel-scale experiments with contact beds of limestone chips, as a means of reducing the aggressivity of a very soft surface water. Based on the findings, full scale units were constructed at the Dillsburg, Pa. plant. His present contribution reveals operating results from this betterment, since May 1937. The results attained and effects secured have passed predictions, based on experimental findings, and Mr. Glace's report contains data and confirming observations of appreciable value in consequence. There are many Dillsburgs in America and lots of limestone, which couldn't be put to better use than that for which employed by the Dillsburg Water Co. under Mr. Glace's direction.

"Financing Sewerage—A Sewer Rental Plan"—by Robert A. Allton, Consulting Engr., Div. of Sewage Treatment, Columbus, O., is a timely presentation of the procedure of financing operation of the new sewage treatment works of Columbus, which its Sewerage Department has evolved. The sewer-rental plan having been selected as being the most equitable method of charging for service rendered, a study of many existing rental ordinances was made before setting up a rate schedule and collection method for Columbus. Mr. Allton, responsible for developing what may be considered a "Sewage Tight" ordinance, presents it as the substance of his article. To many confronted, now or in the future, with planning the financing of sewage disposal the carefully studied ordinance of Columbus, "taken apart and put together" may times by the author, will have a decided value.

"Bacterial Aftergrowths"—by John R. Baylis, Engineer in charge of the Chicago Experimental Filter Plant, and Associate Editor of this magazine, constitutes a presentation of experiences with so-called bacterial aftergrowths in dead ends and sluggish spots in distribution systems. He analyzes the probable cause of these disturbing appearances of bacteria in uncomforting numbers in tap samples, and discusses the question "What Significance?" Mr. Baylis reviews some of his much earlier findings and published comments on this subject. He adds to these, based on more modern concepts and experiences, and discusses the interpretation or question of meaning that is lately being put on the appearance of "aftergrowths" in reservoirs and water mains.

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WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. 85 MARCH, 1938 No. 3

SOME NEW PRACTICES IN WATER SOFTENING

Features of Plant Design and Operations at Springfield, Ill.

By CHARLES H. SPAULDING
General Superintendent, Water Dept., Springfield, Ill.

EVERY now and then a new water-softening plant is designed to utilize new methods of getting improved results. It enjoys the limelight for a year or so until another appears which adds other improvements and leaves out some of the mistakes of the past. This is progress.

The Author (And Conceiver of the Springfield Precipitators)

As operators, it is our function and duty to improve this art of water treatment, with which we are dealing, and bring it a little closer to perfection; always, however, bearing in mind that there is another step ahead. It is interesting to note the accelerating rate at which these improvements are being made. A review, for a moment, of the history of water-softening may be in order.

Water-softening with lime was discovered by Sir Henry Cavendish in 1766. He said that London pump water contained a calcareous substance which was held in solution by "fixed air"—the name by which carbon dioxide gas was known at that time. He said you could boil the gas out or get rid of it by the addition of lime and in this way precipitate the "calcareous substance" which we call limestone. Nothing, however, seems to have been done about this on a practical scale for seventy years. Then it was that Thomas Clark, a Scotch college professor, took out patents on the lime-soda softening process.

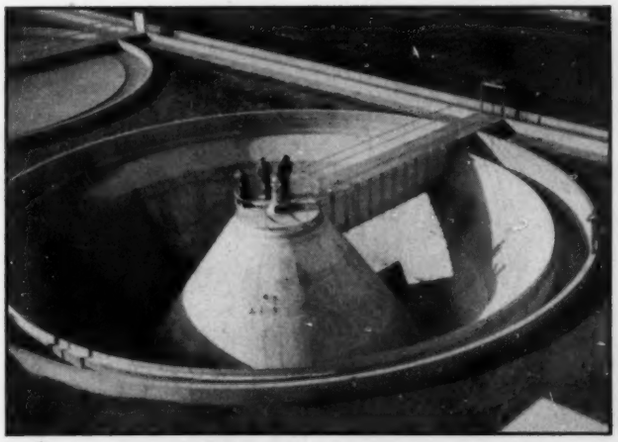
Again, it was a long time before anything was done with lime softening on a large scale in municipal supplies. In 1888, after another 50 years, was constructed a municipal softening plant at Southampton, England. Then, 15 years later (1903), a softening plant was built at Oberlin, Ohio, and this was the beginning of municipal softening in the United States, although previously a plant had been built at Winnipeg.

Here at Oberlin we should pause to look around because this plant attracted wide attention and received some careful study. They learned at Oberlin that the chemical reactions took a long time to reach completion, especially in cold weather. The treated water had three days detention period in the basins, but even that length of time was insufficient to prevent a lot of fouling of the filter beds and some scaling of meters. They found that an excess of lime would speed up the reactions and also that they could split the treatment by intermittent overtreating of the water entering the basins. At Oberlin, they learned the value of coagulants too and, likewise, the fact that the method employed produced a high bacterial efficiency.

The developments which Oberlin was pioneering were seemingly a little too much for purification plant designers for a while, although Columbus was building the largest softening plant in the world in 1907 and took the then radical step (in the face of Oberlin experiences) of cutting the settling time down to 36 hours. By this time lime softening had a good start and the number of plants began to increase.

In Retrospect

The greatest problems in these plants were always those resulting from the lag of chemical reactions in cold dilute solutions. Gradually it became known that prolonged stirring would help matters greatly. This should have been better appreciated long before because it has



One of the Springfield Precipitators Emptied for Inspection. (Treated Water Enters Through Suspended Flume—See Sketch of Section.)

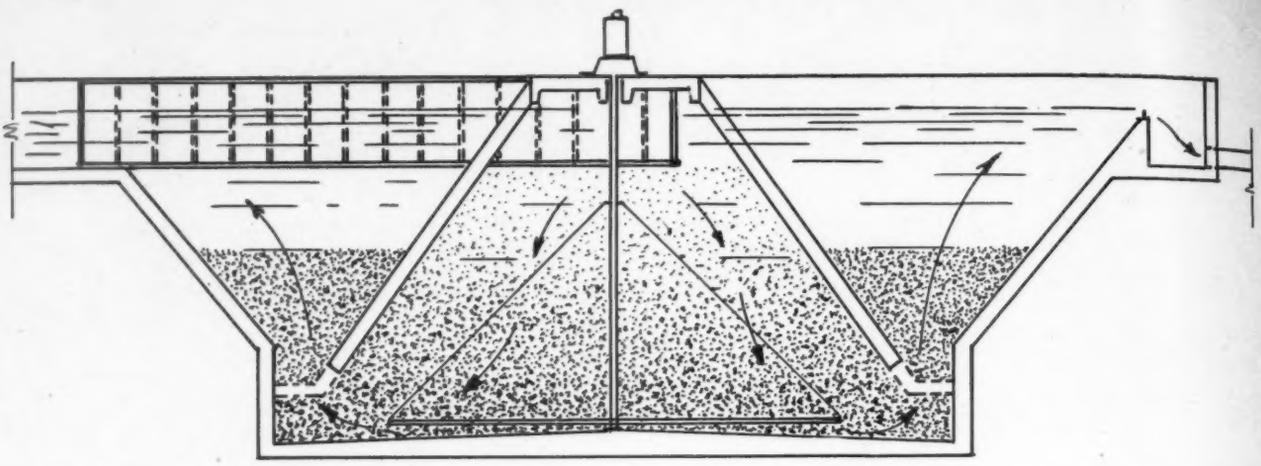


Fig. 1—A "Precipitator" in Sectional View, Showing the Water Swirling Downward and Then the Up-Flow at Diminishing Velocity Through the Floating Sludge Blanket in the Annular V-Shaped Compartment.

been common practice to stir precipitates in the laboratory in order to induce complete precipitation. Eventually engineers have come to fasten their attention upon the high importance of the mixing stage, rather than the settling stage of the treatment.

The second aid to complete reactions was, perhaps, not as obvious as agitation. Sludge in a softening plant was always considered, as something to get rid of, better to be forgotten if possible, especially when trying to "sell" the process to the skeptical. The possibility of putting the sludge to good use was almost completely lost sight of. Based on newer experience and demonstrations, a most effective cure for incomplete chemical reactions seems to have been lying at the bottom of settling basins for the past 100 years. Meanwhile various practices have been introduced to meet the difficulty of slow reactions at added expense of operation. Excess lime did a pretty good job of speeding up reactions, but its use made recarbonation highly essential. Even after recarbonation the water was still unstable due to secondary precipitation of calcium carbonate. While these problems complicated the design and operation of lime-soda softening plants and gave impetus to the zeolite softening trend, the growing demand of the public for soft water has resulted in the construction of many new lime or lime-soda plants in spite of the complications and secondary problems.

With the success of simplified methods, such as are now working satisfactorily at the Springfield, Ill., plant, I believe we will soon be justified in claiming that lime softening is one of the most economical as well as satisfactory methods of water purification. Let us turn now to the features of the Springfield plant which we find to have simplified lime softening practice and made it more economical. The principal features which distinguish the plant from previous designs are the "Precipitators."

The Precipitators

A precipitator is a combination of mixing, coagulation, and settling tank designed to bring the unstable lime-treated water into equilibrium *quickly,* by retaining the previously precipitated carbonates and the hydroxides in suspended contact with the water flowing through. It will be sufficient for this paper to merely recount briefly their construction. (Refer to Fig. 1). Being circular in form, the treated water enters the center at the apex of the inverted conical compartment. It passes downward in this compartment while it is being agitated by a wheel near the floor, 30 feet in diameter, rotating on a vertical axis at 1 r.p.m. At the base of the cone the direction of flow reverses and the water passes upward into an outer annular compartment, which has sloping sides, thus providing the quiescent stage where the solid precipitates settle back into the more rapid stream of water at the base.

The purpose of the design is to maintain the solids in continuous suspension, with as little agitation as possible, and to keep the conditions as near alike as possible at all points in every horizontal section through the settling compartment. The situation is analogous to that which exists in a filter which is being back-washed. In this case sludge is being lifted by flotation and dropping back instead of sand, as in a filter. In this case it is also necessary that the upper velocity be approximately the same at all points in the horizontal plane; otherwise, precipitate would be carried over and clarification would be prevented, just as filter sand would be carried over if the wash water were unevenly applied. In the case of the precipitator we are handling material much lighter than sand, and the upward velocities are much lower than in the case of filter washing; nevertheless, analogous results can be obtained providing the agitation and design of the settling basin is carefully planned.

Probably most of us are familiar with the so-called tests for chemical balance. In this test a portion of water, the alkalinity of which has previously been determined, is shaken in contact with a portion of calcium carbonate powder. The alkalinity of the water is then redetermined after filtering. In the case of softened water, if it is unstable due to the presence of unprecipitated calcium carbonate it will be stabilized by this procedure, with the resultant lowering of alkalinity caused by a farther removal of calcium carbonate. If the water which passes through the plant is treated by a procedure of the same pattern, as was the case with the water which was shaken in the flasks, it is reasonable to assume that we will have a stabilized plant effluent. That is exactly what is now being done on a large scale at the Springfield plant. The mixing stage of the process takes places within and beneath the settling stage. The precipitated solids instead of settling to the floor of the basins, to be continuously removed by some sort of scraper mechanism, or flushed out, fall into the agitating zone and accumulate. The growing sludge depth is held within limits by bleeding into a separate small sludge concentration tank.

Each of the three precipitators at Springfield has a rated capacity of 6 m.g. per hours, based on an arbitrary

TABLE I—CHEMICAL DATA—SPRINGFIELD PLANT

(November, 1936, through August, 1937)

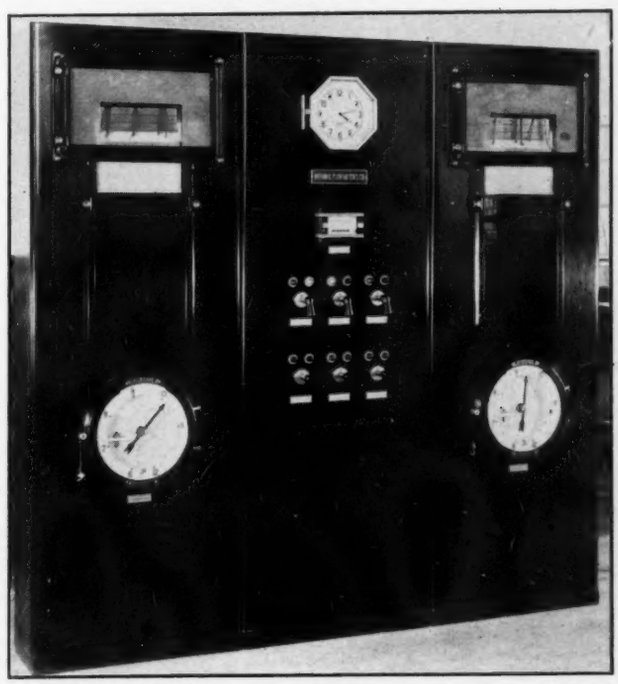
	Alkalinity (P.P.M. $CaCO_3$)										Hardness (P.P.M. $CaCO_3$)							
	—Raw—		—Settled—		—Applied—		—Filtered—		—Final—		—Total—		Non-Carb.		Magnesium		—pH—	
	Tot.	Phenol.	Tot.	Phenol.	Tot.	Phenol.	Tot.	Phenol.	Tot.	Phenol.	Raw	Filt.	Raw	Filt.	Raw	Filt.	Raw	Filt.
November ...	129	0	61	44	49	16	38	11	41	13	162	80	34	41	..	..	8.4	9.2
December	132	0	68	54	33	8	29	5	29	6	167	68	35	39	71	28	8.4	9.1
January	125	0	54	33	39	17	32	13	32	13	162	76	36	43	70	41	8.1	9.5
	(The above not included in average.)																	
February	111	0	44	24	40	21	35	19	36	19	152	84	43	50	65	46	8.0	9.7
March	104	0	40	20	40	20	35	18	35	18	149	89	45	54	67	52	7.8	9.7
April	102	0	38	19	38	19	33	17	33	17	155	86	52	53	67	50	7.7	9.6
May	104	0	40	20	37	18	32	16	32	16	157	92	52	61	69	54	8.3	10.0
June	116	7	36	18	34	17	30	14	30	14	172	92	55	62	73	62	8.7	10.0
July	121	7	43	22	38	18	32	15	33	16	172	90	51	59	73	59	8.9	9.7
August	120	3	43	20	38	18	34	15	35	16	165	87	44	54	72	55	8.6	9.9
Average	111	2	41	20	38	19	33	16	33	17	160	89	49	56	69	54	8.3	9.8

limitation of 2 inches vertical rise per minute just below the flow line of the tanks. The total detention period for mixing and settling at this rate happens to be about 90 minutes, though this does not seem an important factor. As in the case of filter washing, the temperature of the water has an important bearing on the rate at which the precipitators can be operated. This is due to the change in the viscosity of the water with temperature changes. Thus, a unit which is capable of handling 6 m.g. at temperatures near freezing will handle double this amount, without passing precipitate, when summer temperatures prevail. In other words, cold water lifts the precipitate more than warm water. This is rather fortunate because peak loads in water works almost invariably occur during the summer. We have, therefore, frequently preferred to operate a 6 m.g. unit at at 12 m.g.d. rate during warm weather, leaving the second unit out of service. There are three precipitators at Springfield, all of which may be operated in parallel, or the third precipitator may be placed in series with either or both of the first two. A recarbonation basin was provided, so that it could be used either before or after the water passed through the third precipitator. However, recarbonation has not been used since February, 1937, because it was found that the temporary hardness (alkalinity) could be reduced to the lowest desirable figure (30 to 35 p.p.m.) without the use of excess lime treatment and, therefore, without the need for recarbonation. The alkalinity of the final effluent of the filter plant during the past eight months has averaged only 32 p.p.m. We have maintained water which contains normal carbonate without either bicarbonate or caustic alkalinity. In this condition it enters the mains with a slight tendency to provide a protective coating on the pipes.

Operating Experiences

Now, we come to the problem which is nearly always with us in water purification and is receiving much attention. Much is known about corrosion and red water but more remains to be learned, for at the present time we must admit we are still operating on the basis of trial and error. Practically every natural water is corrosive to iron, and we can only hope to minimize the effect by corrective measures. Unfortunately, it happens that the water which we put into the main is not the same as the water which comes from either the cold or hot water tap in a residence miles away. But this is a subject which is aside from the present discussion. The pH of the finished Springfield water has averaged 9.8 during recent months. A lower pH carried during the first three months was found undesirable. It was a source of surprise and concern when we first found this high pH necessary, but on further investigation we were reassured by the fact that several other plants had come to the same practice.

A table of alkalinities and hardness determinations through the plant may be of interest. Table I shows the results of treatment for ten months beginning November, 1936; but continuous operation of the plant did not begin until December, and during the first three months we were using excess lime treatment which was discontinued in January and is not expected to be resumed. Therefore, the average values given do not include the first three months of operation. The table shows that the 111 p.p.m. alkalinity of the raw water was reduced to 33 p.p.m. in the filtered water. The column headed "Settled" is the average of samples which have passed through the first precipitator only. The column headed "Applied" is water which sometimes has passed through



Control and Record Panel

Sixteen Pens Produce a Continuous Record of Operation of the Springfield Plant. Fourteen of These Records Are Produced on Two Strip Charts. Only Two of the Micromax Recorders of pH Require Individual Charts. The Facts Recorded on Strip Charts Are the Rate of Operation of Each Filter; Rate of Flow of Raw Water; Temperature of Each Lime Slaker; Elevation of Water in the Clear Well, Basin, Wash Water Tank; Rate of Flow of Wash Water During Filter Washing; Temperature of the Air, and Raw Water. The Low Lift Pumps Are Started and Stopped by the Control Panel Switches.

TABLE II—OPERATING DATA—SPRINGFIELD PLANT

(November, 1936, through August, 1936)

	Thousand Cubic Meters Delivered	Hours Between Washings (Min.)	Pct. Wash Water	Lime (p.p.m.)	Coagulant (p.p.m.)	Carbon (p.p.m.)	Ammo. Sulfate (p.p.m.)	Chlorine (p.p.m.) to Raw Water	Turbid. Raw	Turbid. Applied	Turbid. Filtered
November	28.00	22	3.0	120.0	11.9	0	1.10	0.5	17.0	15.0	0.5
December	32.12	69	0.97	123.0	9.2	0	0.80	0.44	9.6	8.0	0.05
January	32.40	59	1.1	89.4	{ 10.3 Al { 5.6 Fe*	0	0.83	0.0	15.0	7.0	0.20
				The above not included in average)							
February	33.21	40	1.1	73.0	16.8*	0	1.10	0.6	40.0	3.5	0.05
March	33.0	43	1.2	62.5	18.2*	0	0.84	0.6	46.0	4.3	0.003
April	27.59	42	1.4	72.0	13.7*	0.4	0.70	0.6	44.0	2.6	0.02
May	28.59	80	1.0	70.0	15.4*	1.5	1.20	0.9	26.0	2.3	0.01
June	31.24	58	1.7	78.0	9.4*	2.0	1.60	0.95	14.0	2.0	0.00
July	32.23	48	1.4	79.0	7.2	1.8	2.60	1.4	8.0	2.1	0.003
August	35.21	45	1.4	88.0	9.5	2.1	2.40	1.3	11.0	2.6	0.03
Average	31.58	50.9	1.3	74.6	12.9	1.1	1.49	0.9	28.4	2.8	0.017

*Note: Iron sulphate added February, March, April, May and June, instead of aluminum sulphate 10.3 p.p.m. Iron sulphate added in January also.

the third precipitator in series. There is indicated a drop of 2.7 p.p.m. after the second stage of treatment. The filtered water shows a further drop of 4.9 p.p.m. This indicates that the water applied to the filter was not quite stable, and that the previously coated filter sand is tending to bring the alkalinity down to the limit of solubility. Unless this tendency exists at the filters, there could, of course, be no protection in the mains against corrosion. Reading further across the table we find total hardness of 160 p.p.m. in the raw water has been reduced to 88 p.p.m. in the filtered water. Non-carbonate hardness has been increased from 48 in the raw water to 56 in the filtered water, due to the use of coagulants. Magnesium hardness has been reduced from 69 p.p.m. in the raw water to 54 p.p.m. in the filtered water—all in terms of calcium carbonate.

Table II shows the chemicals which were used during this period. It is always interesting to compare the amount of lime used with the theoretical amount utilized in the chemical reactions. The quick lime which we are using ordinarily averages slightly over 93% (CaO) when received, and may be assumed to be the same when it enters the slaker. The record shows, during the past seven months, 74.6 p.p.m. of lime applied to the water. In order to determine the theoretical amount utilized in the reactions, we add (in terms of calcium carbonate) the bicarbonates, the magnesium removed, and the increase in non-carbonates which is accompanied by a corresponding release of carbon dioxide. These three quantities total in the present instance 129 p.p.m.; this is equivalent to 77.4 p.p.m. of lime accounted for as compared to 74.6 p.p.m. actually used. It may be of interest also to note that 74.6 p.p.m. of lime have resulted in the removal of 71.8 p.p.m. of hardness, net; in other words, each pound of hardness removed has required addition of 1.04 pounds of lime.

The total cost of chemicals at the Springfield plant is averaging $4.36 per million gallons, of which $2.04 per million gallons is for lime.

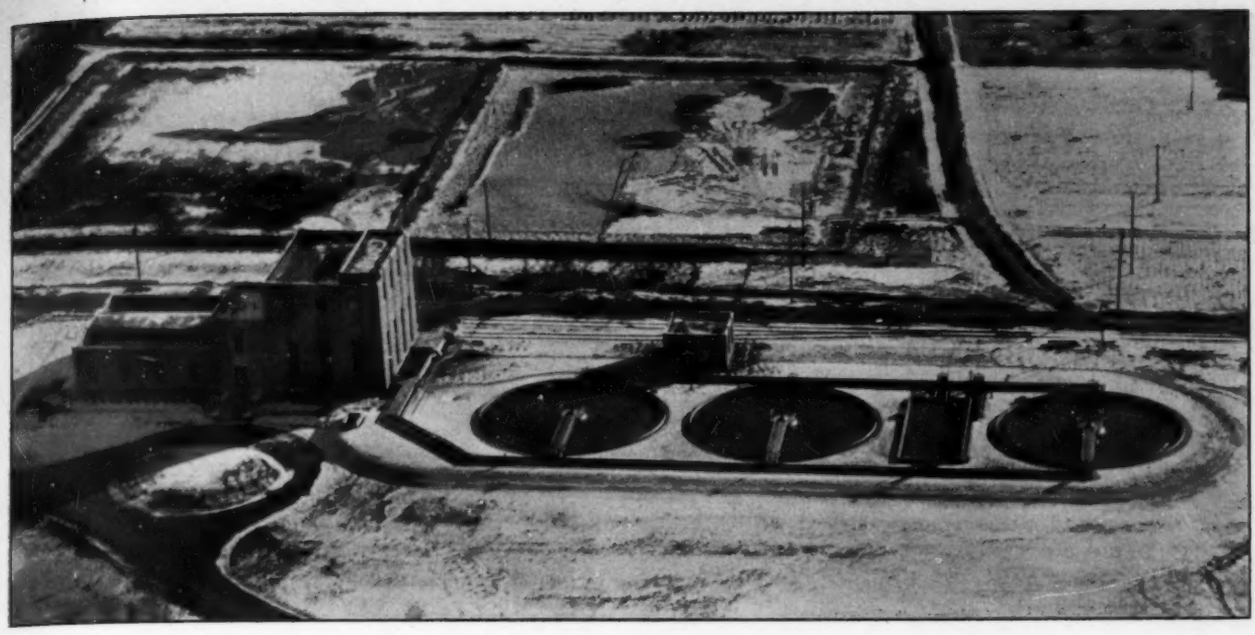
Sludge Disposal

Going back to the precipitator, it may be of interest to know what is the ultimate disposition of the precipitates which accumulate in the process. These are disposed of by allowing the precipitator to "bleed" more or less continuously into the small sludge concentrators, from which the clear supernatant water is returned to the raw water dosing well. The concentrated sludge is removed from time to time by a sludge pump discharging upon a sludge drying bed. This operation is not at all complicated. The rate at which the thin sludge is being drawn from the precipitator depends upon the rate at which the clear water is being pumped out of the concentrator, accomplished with a small pump delivering 100 gallons per minute. This pump ordinarily operates eight to sixteen hours per day, during which period the thin sludge is being automatically bled from the precipitator. A small pump removes the concentrated sludge during a period of four to eight hours per day. The concentration of the sludge in the precipitators varies through a range of 1 to 3% solids. The concentrated sludge ordinarily contains about 10% solids. The sludge drying beds consist of two rectangular fields about 250 ft. square, surrounded by a low earth dyke. Sludge was pumped into one of these fields for about eight months of the year and then diverted into the second field. Meanwhile the first sludge has dried and will doubtless be hauled away by the farmers.

Features of the Filters

From the precipitators we naturally turn to the filters. The thoroughness of the lime treatment has been capitalized to reduce the area of the sand beds. Instead of 2 gallons per minute per square foot of surface, the filters are rated at 4 gallons per square foot and they have handled 25% overload (5 gal./sq. ft./min.) without undue loss of head or sacrifice of quality. This high rate is possible because of the coarseness of sand grains which are all practically in excess of 1 mm. diameter. The sand may be said to have been "raised" at the city's first softening plant where it grew during a 10-year period from an original effective size of 0.4 mm. to its present dimension. At the former plant this increase in size did not apparently impair the quality of the filter effluents. Moreover, it proved the higher rates of operation practical. The ultimate limitation at the old plant would have been inability to wash the filters with the rate available (30 inch rise per min.). At the new plant a 45-inch rise of wash water is available and the sand will be usable for some years.

An advantage of scaled sand is that it more effectively brings the applied water to final chemical balance as it passes through just as the marble test does in the laboratory. Another advantage is the protection against silica which may be dissolved by water of high pH as it passes through siliceous sand. The usual sand specifications requiring insolubility in strong acid are thoroughly



Springfield's New 12 M.G.D. Water Softening Plant

The Three Novel Circular "Precipitators" Provide Mixing, Contact Precipitation, Up-Flow Settling Through the "Sludge Blanket." Total Detention 90 Minutes. The Rectangular Basin, Designed as a Recarbonation Unit, Is Not Used Nor Needed. Sludge Drying Lagoons in Background.

illogical when applied to a lime softening plant. Alkaline insolubility would be more to the point. In this instance the optimum characteristics were conferred by use.

An item which would be at once noticed by an operator visiting the Springfield plant is the omission of wash water troughs. Here there was a practical purpose in view other than the saving in cost of troughs. This purpose was to remove obstructions so that the filter surface could be sprayed with water from a hose just prior to washing.

We had found that filter sand in a lime softening plant can best be maintained in a clean condition by disturbing the surface just before back washing. This can be done by tamping the sand or by jetting it with water at a time when the level of the water in the filter has been drawn below the sand. The reader can demonstrate for himself the basis of this practice if you have a glass tube filter such as is frequently used for wash water and filtration studies. It will appear that the origin of mud balls is the fragmentary surface scum which escapes disintegration in the back wash and at the end of the wash settles below the sand, ready for accretion and toughening during the next filter run. The surface wash of John R. Baylis (Chicago), accomplishes the disintegration of these scum fragments and it can also be accomplished by the surface spray which we are using. The equipment for this procedure is first of all a 100 g.p.m. pump operating against a discharge pressure of 100 lbs. per square inch. A 1½ in. valve at each filter on the discharge lines from this pump carries 22 feet of pressure hose ending in a 1½ in. Spraco nozzle. With this hose and nozzle the filter sand is sprayed just prior to the washing, with the result that the sand is kept clean without undue labor.

The freeboard above the sand in the filter is 15 inches, which is less than the usual, but nevertheless more than it might well be. We may eventually add more sand since any additional freeboard above that required to conserve sand is a hindrance to the washing process. It can now be seen why wash troughs were omitted. With low freeboard there is very little room for a wash trough; furthermore, a trough interferes with the spraying of the surface of the sand. Apparently, the distance which the water travels to the central gullet is not sufficient to interfere with proper washing, and any disadvantage is more than offset by freedom of spraying the surface. Wash water has averaged 1.2 percent. Our washing procedure is entirely arbitrary and is not based upon the loss of head in the filter. During the summer months the filters have been washed every 48 hours; during other seasons this period is sometimes increased to 96 hours, thereby leaving but one filter to wash a day. The practice of washing one or two filters each night at the operator's convenience appears to be a wise policy at this plant because there are but four units. Procedure in washing consists of the following steps:

1. Drain the filters through the effluent valve until the water just disappears below the sand.

2. Spray the surface of the sand with the pressure spray which has been described. Two or three minutes are required in this operation.

3. Open the wash water valve until the rate of rise is 12 to 15 inches per minute for one minute; further open the valve until the rate is 24 inches for one minute. Next open the valve until the rise reaches 45 inches for two minutes; then slow down the rate to the 15-inch rise until the water is clear; this is a matter of one or two minutes more. The rate of application of the wash water appears upon an illuminated dial in the end of the filter room.

To sum up, we may say that operation at Springfield demonstrates several new economies in municipal lime softening, including (1) lower first cost (smaller basins and filters); (2) economy of lime due to maximum utilization of lime and elimination of excess lime treatment; (3) omission of recarbonation.

Acknowledgment—In its original form this paper was read before the Missouri Water and Sewerage Conference, at Lakeside, Mo., Oct., 1937. For WATER WORKS AND SEWERAGE it has been simplified somewhat.

BIO-FLOCCULATION AND CONTACT AERATION

A Report of Experimental Development at Two Texas Plants

By E. W. STEEL

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The Author

IN 1927 Waco, Texas, completed an activated sludge plant having a capacity of six million gallons per day. Operating costs have been at the usual level in plants of this type, and attempts at evolving an air use economy, lead the operator, C. C. Hays, to make experiments in the hope of lowering costs. The principle of contact aeration to produce bio-flocculation was tried, with certain innovations. The results give promise that this method will prove a highly valuable one in future practice of sewage or industrial waste treatment.

Contact aeration had already been tried by Imhoff, Bach, Mahr, Sierp in the sedimentation chambers of German Imhoff tanks; by Buswell and Pearson at the Univ. of Illinois, with their nidus racks. The Germans, in the beginning, employed lath as the contact medium while Buswell and Pearson constructed their nidus racks from veneer or basket material. In each case unsettled sewage was treated and a small amount of air, 0.13 to 0.4 cubic foot of air per gallon of sewage, was applied.

After some preliminary laboratory experiments at Waco a small treatment plant was constructed. It consists of 9 aeration units; each being 6 ft. deep, 3 ft. wide and 3 ft. long. The total area is 108 square feet. A settling tank, having a capacity of 390 gallons, was also constructed and the piping was so arranged that one of the grit chambers of the main plant could also be used for settling.

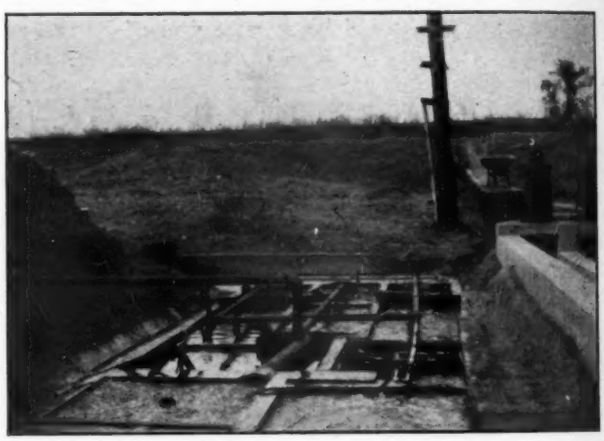
In the laboratory work, and the early trials of the Waco experimental plant, several observations were made which indicated that contact aeration along slightly different lines held more promise than had been indicated in previously published findings of others. The early work was primarily an improvement of the colloider first tried by Travis, an arrangement of plane surfaces on which adsorbed colloidal matter accumulated from the raw sewage. Later experimenters used air to keep the colloidal material from becoming septic. In the German developments the air also was relied upon to dislodge the accumulated colloidal matter, while the nidus racks at the University of Illinois were agitated mechanically from time to time for the same purpose.

Clyde C. Hays City Chemist Waco, Tex.

The Process in Brief

Early in the Waco experiments it appeared that contact aeration of settled sewage had advantages over attempting to treat raw sewage. Apparently when raw sewage came into contact with the surfaces the solids accumulated so rapidly and sloughed off so quickly that but little change in their character was realized. With settled sewage, on the other hand, a zoogleal jelly of very definite characteristics was obtained. It was next found that the aerated jelly showed progressively changing characteristics through the aeration units, from stage to stage, provided the sewage passed through without short-circuiting or back-flow to complicate the progression in the treatment. When short-circuiting was effectively prevented by constructing a long narrow aeration tank, with frequent cross walls, an immediate improvement in the process and effluent was noted. (See sketch.) It was also found that stone or similar hard-surface material was preferable as contact surfaces to wood.

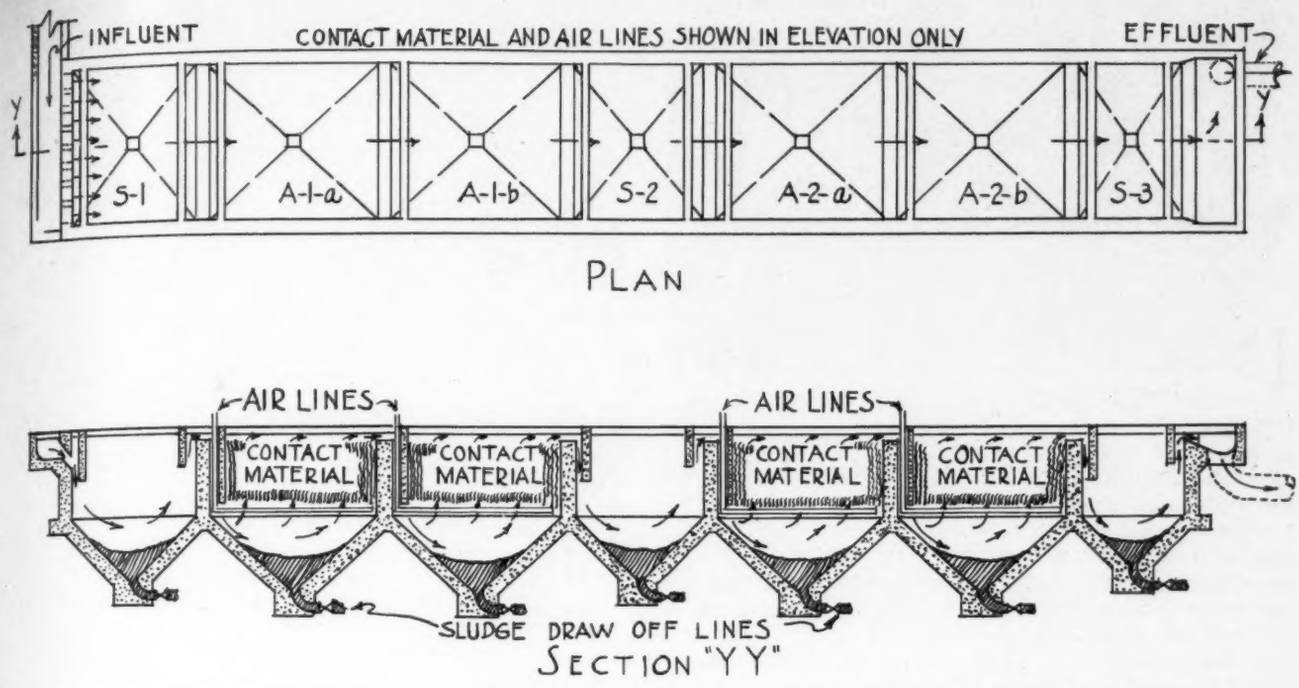
The zoogleal jelly in the first part of the process is rather heavy and gray in color. Examined under the microscope it is found that beggiatoa is the predominating form of life in the slime of the first stages. Since these organisms are very active in the destruction of hydrogen sulfide, it was apparent that, in addition to coagulation of colloidal matter, active reduction of the nuisance-producing sulfides was also going on. Gradually, through this first stage of the process, the sewage also begins to accumulate dissolved oxygen.



The Hays Experimental Bio-Flocculation Unit at Waco.

After a period, representing about 60 per cent of the total aeration time, the coating on the medium changes from an opaque gray to a thin transparent jelly-like film. Here the predominating organisms are those which are found only in the clearer water, such as the diatom navicula, viridis, etc. At the same time beggiatoa rapidly decrease in numbers, until they are entirely absent long before the sewage has passed through the whole process. The experiments indicated that methods to insure segregation of the various types of organisms are highly important in this process which develops stage by stage.

That the final phases of the process are essentially of a type leading to a high stability, is indicated by the chemical tests. Dissolved oxygen increases considerably and the nitrates begin to appear in considerable quantity.



Sketch of the Contact Bio-Flocculation and Aeration Plant of the Hays Type. [*S-1, Pre-sedimentation Tank; A-1-a and A-1-b, First Stage of Contact Aeration; S-2, Intermediate Settling Tank; A-2-a and A-2-b, Second Stage of Contact Aeration; S-3, Final Settling Tank.*]

During the process there is a continuous peeling of the slime coating from the medium. This must necessarily be carried through the contact unit and it was considered advisable to place a settling basin beyond the point at which the sulfide-splitting organisms had apparently finished their work—namely, the first stage. This was done, and, in addition to removing the relatively heavy particles of film, the settling also served to bring about an even sharper division between the action of the sulfide-splitters and the clean-water forms of organisms. It indicated further that the bulk of the oxygen demanding matter had now been removed, leaving only the work of nitrification to be completed in the latter portion of the aeration process.

The Experimental Plant

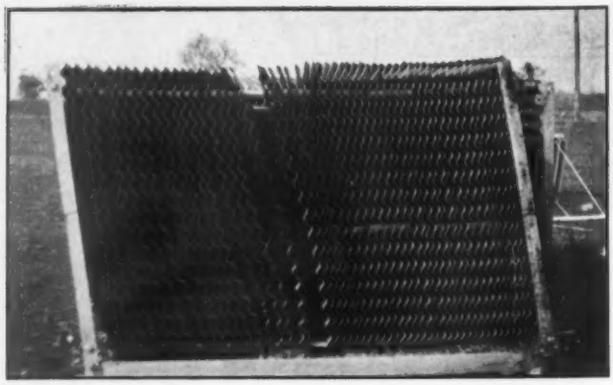
The scheme of construction is shown in the accompanying sketch. The sewage is first given presedimentation, for a period of 30 minutes to one hour, in the settling basins of the main plant. The sewage then passes over a submerged weir and downward between the main end wall and a curtain wall placed four inches therefrom. It is then discharged beneath the contact medium. Also beneath the medium is the air diffusion grid of perforated pipes, or porous tubes of small diameter, extending across the tank. The sewage then rises with the air and comes into intimate contact with the decolloidizing medium at the same time. Particles of film dislodged are also carried up with the sewage. There is some tendency for accumulation of solid matter below the grid, and a hopper is provided with a pipe for drawing off any sludge which may accumulate.

After rising through the contact medium the sewage moves horizontally in a thin sheet to the weir leading to the next unit, which is arranged in the same way. As many units are provided as the sewage requires. Then follows the intermediate sedimentation basin, providing settlement for a period of thirty minutes at the end of the first-stage aeration. It then runs to another series of aeration units of the same type and then receives a third, and final, settlement during a retention period of only nine minutes. Being poorly baffled, the lowest gravity suspended solids are not removed in the final chamber of the experimental plant. This is of no great consequence, however, as these are rather light, both in characteristics and quantity, and apparently are not very putrescrible.

Various types of contact media have been tried. Laths apparently do not present the most favorable conditions for the process. Crushed stone, two to three inches in size, has been used in most of the experiments. To date there has been no clogging of this material. It has been recognized, however, that engineers may fear clogging at plants where the sewage receives inefficient preliminary treatment or where, by accident or through poor specifications, stone of less than two to three inches in size is used. Accordingly, experiments were made with concrete cylinders two inches in diameter, stocked horizontally on three-inch centers and staggered; and also with corrugated aluminum plates placed vertically one inch apart. All three types appear to be of media nearly equally efficient, in so far as effluent quality is concerned Corrugated aluminum plates are expensive, but the large void space between such plates, (92 per cent as compared with 40 per cent with crushed stone) permits smaller tanks for a given capacity and the net increase in first cost for a plant would apparently be small. A few experiments indicate that the cost of aluminum may be reduced still further by using expanded aluminum plaster lath in the first-stage aeration units, where the film is thick and stringy. The aluminum plates are also entirely satisfactory for the first-stage aeration but not quite so efficient for the nitrifying stage where the film is thin and, not being filamentous is less tenacious. There was no sign of corrosion of the aluminum.

Experimental Plant Performance

The results of the experiments are shown in the accompanying tables. Table I shows the average results



Corrugated Aluminum Contact Plates Used in First Stage of Process.

over a three-month period when using a presedimentation period of one hour; a first aeration period of 0.75 hour; second sedimentation, 30 minutes; second aeration period of 1 hour and 40 minutes; final (third) sedimentation, 10 minutes. The air used varied from 1.25 to 1.8 cubic foot per gallon, with a pressure of 2.6 pounds per square inch at the compressor. For comparative purposes the analyses of the effluent of the city's activated sludge plant for the same period are given. It will be seen that the B.O.D. of the presettled sewage was reduced 87 per cent by the experimental plant, as compared with a 77 per cent reduction by the city plant. Reduction of suspended solids was also better in the experimental plant.

Table II shows a later series of experiments. The columns showing the effluent from the second sedimentation tank reveals the effect of the first-stage aeration. During these experiments the total aeration period was about 2 hours, with the first-stage period increased to about 1.25 hours and the second stage reduced to 0.75 hour. The air consumption was 1.5 cubic feet per gallon at a pressure of 2.5 pounds per square inch at the compressor. The effect of the first-stage aeration in reducing B.O.D., and the second stage, in providing nitrification, are clearly shown in this table. During the period covered by Table II several different media were used, cement mortar cylinders, aluminum plates and crushed stone. The stone was used most of the time, however.

The results of tests made from May to November, 1933, are shown in Table III, using the cement mortar cylinders entirely as the contact medium. Aeration periods and amount of air were the same as during the period covered by Table II. Check analyses of composited samples, made at Fort Worth and the A. & M. College, are shown in Table IV.

Concrete Cylinders Used in Contact Media in Second Stage of Hays' Process.

TABLE I—AVERAGES OF SAMPLES COLLECTED DURING 3-MONTH PERIOD OF PRELIMINARY EXPERIMENTS

	Raw Sewage p.p.m.	Pre-Sedimentation Effluent p.p.m.	Effluent Experimental Unit p.p.m.	Effluent of City Plant p.p.m.
Free ammonia	30.9	...	5.8	6.3
Oxidized nitrogen	...	...	16.2	11.8
Dissolved oxygen	...	...	4.7	3.9
B. O. D.	253	108.6	14.1	24.9
Suspended solids	248	111.0	17.0	21.3

TABLE II—AVERAGES OF SAMPLES COLLECTED DURING A 4-MONTH PERIOD OF OPERATION

	Raw Sewage p.p.m.	Pre-Sedimentation Effluent p.p.m.	Effluent Second Sed. Tank p.p.m.	Final Effluent p.p.m.
Free ammonia	31.2	29.8	28.6	3.8
Oxidized nitrogen	...	...	tr.	7.8
Dissolved oxygen	...	...	1.2	4.6
B. O. D.	294	116	33	7.2
Suspended solids	238	94	21	5.3

TABLE III—AVERAGES OF TESTS COVERING MAY TO NOVEMBER, 1933

	Raw Sewage p.p.m.	Pre-Sedimentation Effluent p.p.m.	Effluent Second Sedimentation p.p.m.	Final Effluent p.p.m.
Free ammonia	29.3	28.4	28.2	3.8
Oxidized nitrogen	...	...	...	6.8
B. O. D.	234	97	28	8.6
Oxygen consumed	73	23	9	3.6
Dissolved oxygen	...	...	1.2	5.6
Suspended solids	228	98	20	7.8

TABLE IV—CHECK ANALYSIS, (a) AT LAB. OF TEXAS ENG. EXPT. STATION, (b) AT THE LAB. OF THE FORT WORTH SEWAGE TREATMENT PLANT

	Raw Sewage p.p.m.		Pre-Sedimentation Effluent p.p.m.		Effluent Second Sedimentation p.p.m.		Final Effluent p.p.m.	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Free ammonia	...	24	20	23	8	22	3	22
Oxidized nitrogen	...	...	0.2	..	0.2	..	7.05	7.1
B. O. D.	270	255	70	93	60	59	19	15
Oxygen consumed	...	57	..	34	..	32	..	14
Dissolved oxygen	...	...	..	..	..	tr.	..	5.2
Suspended solids	228	...	32	..	20	..	24	..

TABLE V—EXPERIMENTS WITH HAYS PROCESS AT THE BRYAN SEWAGE TREATMENT PLANT IN 1935

	Influent				Effluent*			
Date of Sample	pH	B.O.D. p.p.m.	Susp. Solids p.p.m.	Per Cent Ash	pH	B.O.D.* p.p.m.	Susp. Solids* p.p.m.	Per Cent Ash
June 28	7.5	235	113	38.9	7.8	55	79	63.3
July 20	7.7	160	109	32.1	8.1	60	42	26.1
Aug. 9	7.9	260	134	36.5	8.2	50	13	19.2
Aug. 19	8.4	330	266	34.2	8.4	40	11	22.7
Aug. 23	7.8	215	104	27.8	8.2	27	11	8.7
Aug. 28	8.1	250	71	23.9	8.6	40	64	67.9
Sept. 6	8.1	190	109	33.0	8.5	16	10	10.0
Avgs...	7.8	234	130	35.5	8.3	41	33	31.1

*Representing only the first (i. e., bio-flocculation) stage of the Hays Process as developed and employed at Waco.

A. & M. College Experiments

Contact aeration was tried on a small scale by the Texas Engineering Experiment Station following the

methods developed by Mr. Hays. The studies went forward under the direction of P. J. A. Zeller and the writer. A small aeration tank was constructed and placed at the activated sludge plant of the city of Bryan. The tank contained four compartments, each being five feet deep and filled with stone specified to be 1½ to 2 inches in size. This size was used because it was easily available. The air consumption was 1.5 cubic feet per gallon and the aeration period was one hour. A sedimentation period of 30 minutes was given after the aeration. The unit received settled sewage from the Bryan primary sedimentation tank and handled about 6,500 gallons per day. The air used was taken from the compressors serving the city plant and was passed through a meter. The unit operated from June to September 6, 1935, with results as shown in Table IV. The samples tested were not composited but were staggered according to retention periods in the various units.

Since only a one-hour aeration period was given, the Bryan results should be compared with those of Waco at the end of the first stage of the Hays process. The Bryan results were better, however, than those obtained at Waco. At Waco, as indicated by Table III, the average B.O.D. of the sewage applied to the contact aerator was 97 p.p.m. and first-stage aeration and sedimentation reduced the B.O.D. to 28 p.p.m., representing a 71 per cent reduction. At Bryan the applied sewage had an average B.O.D. of 234 p.p.m. and it was reduced to 41 p.p.m., representing an 82.5 per cent reduction. The reduction in suspended solids, however, was slightly greater at Waco—namely, 79.6 per cent as compared with 76.2 per cent at Bryan. The average relative stability of the Bryan experimental plant effluent was 64.4 per cent. The results of contact aeration at Bryan were, it is of interest to point out, far better than those obtained by the Bryan activated sludge plant during the same period.

During the last week of operation of the Bryan experimental plant some interference with the circulation of air was noted in two of the aeration compartments. However, this apparently had little or no effect upon the quality of the effluent. When the plant was dismantled it was found that some fine material (¼ to ½ inch in size) had been placed in the coarse material by mistake. These isolated masses of fine material had clogged, but there was no clogging where the material was uniformly 1½ to 2 inches in size.

Mr. Hays reports that the sludge produced by the process, not including the presedimentation sludge, has amounted to approximately 3,000 gallons per million gallons treated. The dry solid content of the sludge is about 4 per cent. Of this amount more than 60 per cent will be produced in the first-stage aeration. The above sludge volume includes the portions removed from the hoppers under the aeration units, as well as those obtained in the sedimentation units. Beyond the second sedimentation tank the amount of sludge recovered from the hoppers decreases sharply.

Discussion

Of importance in the operation of a contact aeration unit would be the effects of industrial wastes and digester supernatant liquid upon the character of the effluent. The Waco unit has taken the usual Waco sewage, including supernatant liquid from the digestion tanks, without any sign of disturbance. The unit appears, therefore, to have none of the tendency for upsets that are expected in the activated sludge process.

From the five years of operation of the Waco experimental plant it appears that contact aeration, of the type developed by Hays, is well worth full scale plant trial. The advantages which the process seems to possess are of importance. It is seemingly not subject to the upsets of the activated sludge plant, since it does not employ the somewhat delicate activated sludge nor is recirculation of sludge practiced. There is considerable flexibility permissible in plant design, for a short aeration period will give practical stability while longer periods will give an effluent equal to those of activated sludge plants. A plant may seemingly be designed to produce a well nitrified effluent with assurance to the designing engineer that overloading will not disastrously upset plant action, but will be confined to lowering the effluent quality during overload or shock periods.

Furthermore, it should be easy to add plant capacity by constructing a few more contact aeration compartments. The loss of head in the aeration units is essentially zero. At the Waco experimental plant the air used (probably more than necessary) actually raised the liquid level, due to the air lift effect. The amounts of air required at the Waco experimental plant for the strong sewage were close to those used for complete treatment at some activated sludge plants. The air pressure, however, was less than one-half that necessary at the standard activated sludge plant, and should permit considerable power saving. It appears possible that increasing the depth of the aeration units should permit lower air consumption with, however, some increased pressure. Hays suggests a rate of air application (with 2 to 3 inch crushed stone) of 0.55 cubic foot per square foot of tank area per minute. If this rate of application is also applicable to contact media having 92 per cent voids, such as the aluminum plates, power costs should be very low.

Although the Waco experimental unit has been operating for five years it is still being observed and, as time permits, more information will be obtained.

▼

N. Y. WORLD'S FAIR APPOINTS SANITARY ENGINEERING COMMITTEE

The New York World's Fair has named a Committee of Sanitary Engineers to advise World's Fair officers and planning groups on matters pertaining to educational exhibits involving Public Health and Sanitary Engineering —water supply, sewage treatment et al.

Heading the Committee as Chairman is Sol F. Pincus, Chief Sanitary Engineer, N. Y. City Dept. of Health. Others serving are:

Walter D. Binger, Engineer—Commissioner, Dept. of Sanitation, New York.

Chas. A. Holmquist, Chief Engr., State Dept. Health, Albany.

Dr. Abel Wolman, Johns Hopkins Univ., Baltimore.

H. E. Jordan, Exec. Sec'y, A. W. W. A., New York.

Prof. Lewis V. Carpenter, N. Y. Univ., New York.

Chas. A. Emerson, Consulting Engineer, New York.

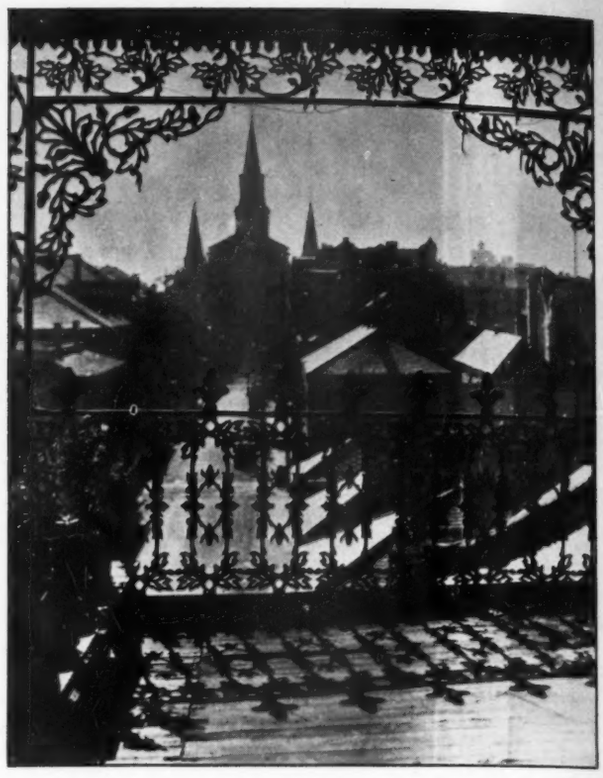
Frank W. Herring, Exec. Sec'y, Am. Pub. Wks. Ass'n, Chicago.

J. L. Barron, San. Engr. of Westchester Co., White Plains, N. Y.

Linn H. Enslow, Editor WATER WORKS AND SEWERAGE, New York.

DOWN TO "N'ORLANS" WITH A.W.W.A.

A. W. W. A. Specials from East and West to Meet at the Cast-Iron Pipe City for Day Stop-over—Then to America's Riviera on the Gulf, and on to the Carnival City



A Glimpse of Old N'Orleans from a Balcony. Famous Is the Cast Iron Lace Work That Has for Generations Defied the Corrosive Atmosphere of the Vieux Carre. There Also One Finds Cisterns of Bolted Cast Iron Plates.

TO the membership of the American Water Works Association pictorial folders have been issued, to reveal arrangements made by the Convention Transportation Committee for an interesting routing of the A.W.W.A. Convention Specials from East and West to the New Orleans Convention April 25-28th inclusive. For the arrangements, again A.W.W.A. has called on John S. Warde to handle the arrangements, as Chairman of the Sub-Committee on Transportation of the Convention Management Committee, of which W. J. Orchard is "General Manager."

The A.W.W.A. Special from the East has been routed to pick up the greatest numbers en route. We hear too that the Chicago contingent, growing stronger daily, has declared that it too will roll up a sufficient number of conventioneers to send out a "Chicago Special" to take to Dixie Land conventioneers from the North and Central-West. The accompanying map shows indicated rail routings to the meeting point en route to New Orleans-Birmingham, Alabama.

Since Birmingham with its many important pipe foundries has come to be known as the "Cast Iron Pipe City" it seems highly appropriate that the Transportation Committee has arranged to have all trains lead to Birmingham where conventioneers will join together from North, East, Southeast and West for a day stop-over for the purpose of seeing cast-iron pipe made.

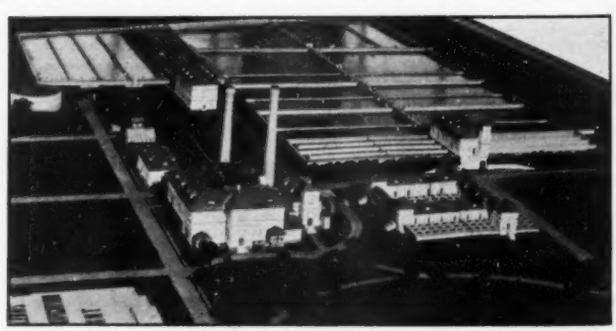
If You Would Know What Happens in New Orleans When It Rains, Just Go to This Pumping Station. All Sewage and Storm-water Must Be Pumped Out of New Orleans. This is One of Several Gigantic Drainage Pumping Stations.

Order of the Day

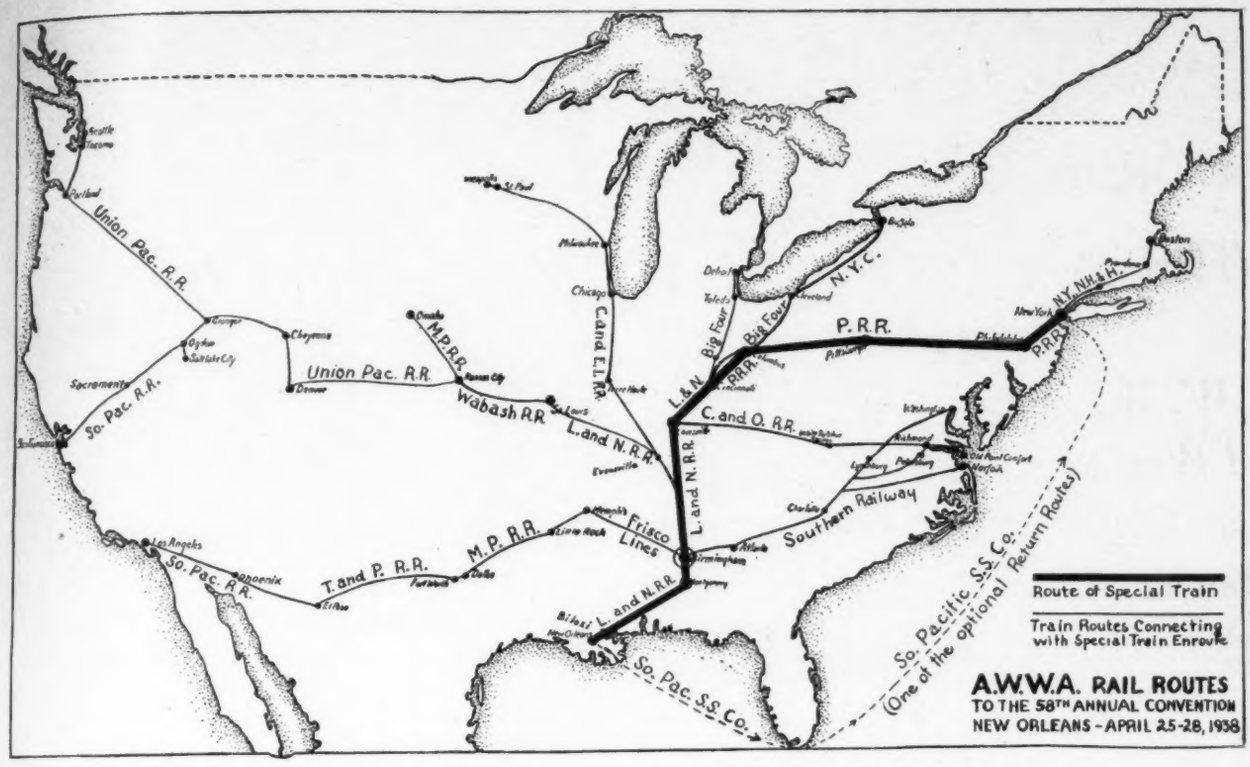
Arriving early on April 23rd (Saturday), A.W.W.A. members and guests will be transported as guests of the cast-iron pipe manufacturers to inspect the American, the National, the McWane and U. S. Pipe Companies' foundries. (These companies, ordinarily not operating on the short day, are going to considerable operating expense to have their plants running for the benefit of the special visitors, so that they may see cast-iron pipe made by the several modern methods now employed in pipe production.—Ed.)

During this time the ladies have the option of enjoying the beauty spots of "Birmingham in the Spring" by way of a sight-seeing tour which will end at Birmingham's Country Club for luncheon.

Birmingham has become famous also for its novel $6,000,000 Industrial Water Supply Project (described



New Orleans Filter Plant and Pumping Station.



Rail Routes to the 58th Annual Convention of A. W. W. A., New Orleans, April 25-28.

in previous issues of this magazine) which is now nearing completion. To see the dam, pipe line and regulatory and treatment works of this unusual project, special transportation is being arranged for an afternoon tour of inspection by those desirous of going. Golf is also being arranged for at the Country Club in the afternoon for those who wish to play, and the ladies will have the afternoon to do as they most desire at the club or elsewhere. An old-fashioned Barbecue is being arranged at the Dam for all who take in the Industrial Supply inspection.

At a special dinner at the Hotel Tutweiler all will gather again. And, at 9:25 p. m. the Consolidated A.W.W.A. Specials will roll out of Birmingham for the Gulf Coast city of Biloxi, Miss., to have breakfast Sunday morning at the Buena Vista Hotel. After breakfast; to motor coaches for the "trip of trips" along the beautiful Gulf Coast (the "Riviera of America") to Pas Christian to visit, amongst other spots, the unique Japanese Gardens of Mr. Rudolph Hecht.

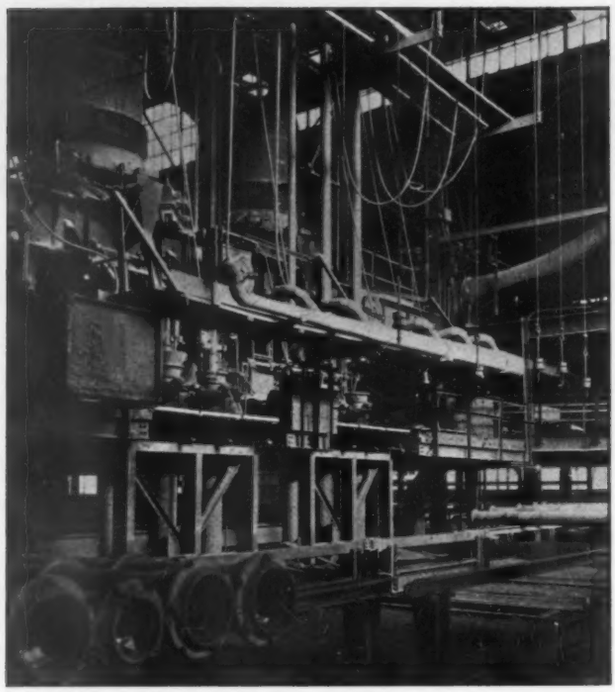
Then to luncheon at Hotel Miramar, and back on the Special to roll down to the delta of "Old Man River" and into the Convention City of Mardi Gras at 5 p. m. Sunday, April 24th. All of which is in time for dinner at one of the far famed restaurants, or in a quiet and picturesque high-walled garden restaurant, of which there are many in the old French quarter—the Viex Carre. Oh, yes! We must not overlook the Sazarac Cocktail of New Orleans fame.

The special transportation folder of A.W.W.A. shows the following train schedules:

All Aboard!

Lv. Boston	"The Pilgrim"	4:00 P. M. April 21
Lv. New York	Penna. Ry.	11:35 P. M. April 21
Lv. North Philadelphia	Penna. Ry.	1:03 A. M. April 22
Lv. Pittsburgh	Penna. Ry.	9:00 A. M. April 22
Lv. Columbus	Penna. Ry.	2:00 P. M. April 22
Ar. Cincinnati	Penna. Ry.	5:05 P. M. April 22

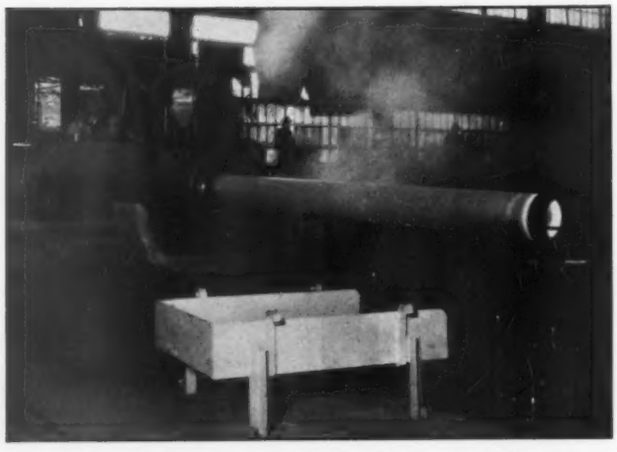
The Spires of St. Louis Cathedral Look Down on a City 220 Years Young. Along One Side Runs Famous "Pirates' Alley"; on the Other St. Anthony's Garden, Once a Famous Dueling Ground; in Front Is the Place d'Armes, There Since 1720.



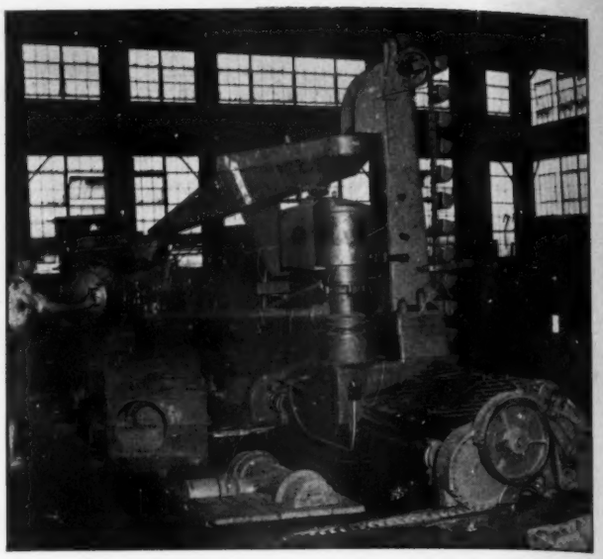
Here Is an Interesting Station in ACIPCO'S Plant. The Importance Attached to Sand Conditioning and Mould Making Will Be Seen Everywhere in Evidence in ACIPCO'S Interesting Sand-Cast Centrifugal Pipe Shop

Lv. Buffalo	N. Y. Central	7:20 A. M. April 22
Lv. Cleveland	Big Four	12:15 P. M. April 22
Lv. Detroit	Mich. Central	11:45 A. M. April 22
Lv. Toledo	Big Four	1:15 P. M. April 22
Ar. Cincinnati	Big Four	5:55 P. M. April 22
Consolidation from North and East		
Lv. Cincinnati	L. & N.	7:00 P. M. April 22
Ar. Louisville	L. & N.	9:35 P. M. April 22
Lv. Norfolk, Va.	C. & O.	7:00 P. M. April 21
Lv. Richmond	C. & O.	10:15 P. M. April 21
Lv. Washington, D. C.	C. & O.	10:40 P. M. April 21
Lv. Huntington, W. Va.	C. & O.	11:22 A. M. April 22
Ar. Louisville	C. & O.	5:20 P. M. April 22
Lv. Louisville, Ky.	L. & N.	9:45 P. M. April 22
Ar. Birmingham	L. & N.	7:30 A. M. April 23
Lv. Greensboro, N. C.	So. Ry.	6:55 A. M. April 22
Lv. Charlotte	So. Ry.	9:30 A. M. April 22
Lv. Atlanta	So. Ry.	3:40 P. M. April 22
Ar. Birmingham	So. Ry.	8:15 P. M. April 22

(Or there can be a stop-over in Atlanta, leaving at midnight for Birmingham)



What Makes Super de Lavaud Pipes "Super"? At the U. S. Foundry in Birmingham This, and More, Will Be Demonstrated. Here Is a "Fresh" One Emerging from the Casting Centrifuge.

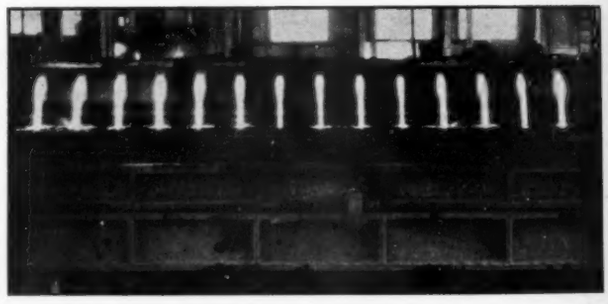


What Has Sand Condition Got to Do with Good C. I. Pipes? This "Sand Slinger" in National's Foundry Has an Important Function in Making Good Moulds and They Think Lots of It.

Lv. Minneapolis	C., M. & S. Paul	11:15 P. M. April 21
Ar. Chicago	C., M. & St. Paul	7:50 A. M. April 22
Lv. Chicago	C. & E. L.	2:30 P. M. April 22
Lv. Terre Haute	C. & E. L.	6:10 P. M. April 22
Lv. Evansville	L. & N.	8:55 P. M. April 22
Ar. Birmingham	L. & N.	7:30 A. M. April 23
(Consolidated A. S. S. A. Special)		
Lv. Birmingham	L. & N.	9:25 P. M. April 23
Ar. Biloxi, Miss.	L. & N.	7:00 A. M. April 24
(Gulf Coast Drive to Pas Christian)		
Lv. Pas Christian	L. & N.	3:20 P. M. April 24
Ar. NEW ORLEANS		5:00 P. M. April 24

And the Show Is On!

Four days and five nights of conventioning, sightseeing by day (of which there can not be too much in this city of history, romance, glamor) seeing "the spots"



McWane's Unique Method of Pipe Casting. Daily Filling the Moulds of Many Miles of Small Diameter C. I. Pipes.

and the sights by night. Before one knows how, a week goes like magic in Nouvelle Orleans. If one has been there once he will need no encouragement to go again.—And, besides, to see A.W.W.A. in action. If one has never seen "N'Orlans", there is no description which can do it justice. Just go and see; breathe for yourself the jasmine perfumed air and sit out in the languid night air, which carries with it the spell of romance or "Mardi-Gras—and some say it breeds a fever called "Manana." But go for yourself and see!

For rail and pullman fares, hotel listings, or other information, address John S. Warde, Chairman A.W.W.A. Transportation, care Rensselaer Valve Co., 50 Church St., New York City.

[The Program of Technical Sessions appeared in our February issue. There's much to commend it to your attention.—Ed.]

The Manville, N. J., Plant.

NEW JERSEY'S PROGRESS IN ALLEVIATING STREAM POLLUTION*

Accomplishments in Systematic Treatment Works Construction for Three Major Drainage Basins

By DR. WILLEM RUDOLFS[1]

Rutgers University,
New Brunswick, N. J.

DURING the last few years rapid progress has been made in the elimination of pollution from the Raritan, Elizabeth and Rahway Rivers. In order to present a birds-eye picture, it is well to know something about the degree of pollution and the events which led to the clean-up, as well as the measures taken.

The Author

River Conditions

Raritan River. The population in the lower Raritan River Valley is over 210,000, discharging some 16 mgd. of domestic sewage. In addition, a similar amount of industrial waste reaches the river. Only some 3.5 mgd. of this sewage received treatment, and practically none of the industrial waste was treated. The condition of the river made it hazardous to use it for swimming or bathing; several industries began to have difficulty with their processing water; the shellfish seed beds at the mouth of the river and the oyster grounds were abandoned; the general discoloring of the waters, floating materials and sludge banks, destroyed the esthetic features of the river, to such a degree as to affect real estate values.

During the summer certain sections of the river were at times nearly void of oxygen. The Coliform organism content of the river water was exceedingly high, records available showing as many as 12,000 and 14,000 per cubic centimeter at times.

Rahway River. Surveys showed that the raw sewage of several communities and considerable quantities of trade wastes were discharged into the river. Some of the trade wastes created undesirable taste and odors in water taken from the river for potable supply, while the lower section of the river was black and odorous. Analytical results showed that certain sections of the river had no oxygen left during the summer and that the B. coli content was exceedingly high.

Elizabeth River. The Elizabeth river received the raw sewage of a number of municipalities and in addition to the organic waste the water of the lower section received chemical and oil wastes. After construction of a joint sewer an estimated amount of 50 mgd. of raw sewage coming from the Elizabeth, Rahway and part of the Raritan valleys entered the Arthur Kill. The

*Journal Series paper, N. J. Agricultural Experiment Station, New Brunswick, N. J., Div. Water & Sewage Research.

[1]Chief, Div. Water & Sewage Research.

To the Manville Plant Runs a 30-In. Sewer of the New Asbestos-Cement "Transite" Pipes.

dissolved oxygen saturation of the Arthur Kill gradually decreased until a minimum of 10 to 12 per cent was reached. The industrial and domestic wastes caused considerable floating material to be present and discolored the waters materially.

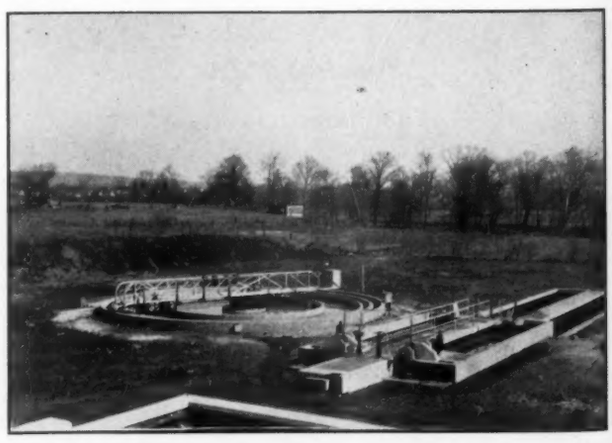
A Bit of History

Events leading to abatement of pollution on the three different water-sheds and the methods pursued to obtain cleaner streams varied. The communities along the Raritan discharged sewage individually, while in the Elizabeth valley a number of municipalities were served by a trunk sewer for many years.

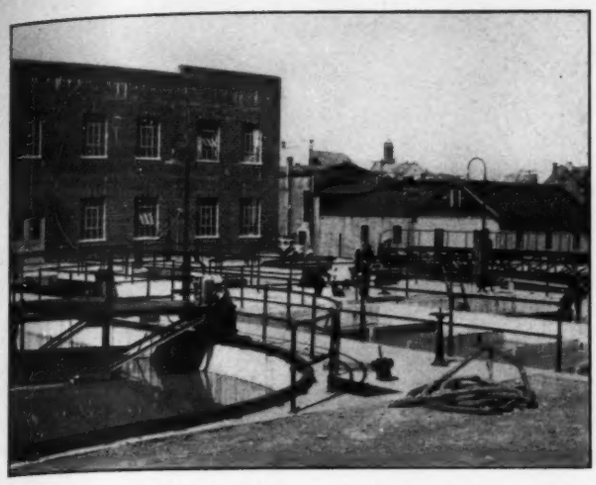
The Raritan. During 1924-25 a group of public spirited citizens organized themselves into the "Raritan Valley Improvement Association" for the purpose of abating the pollution of the river, restoring boating, bathing and fish life and for the general improvement of undesirable conditions. This association undertook an active publicity campaign to arouse interest in pollution abatement as a drainage basin program. The rapidly progressing pollution was a case of concern to the Port Raritan District Commission, and this led to a rather exhaustive chemical and bacteriological study of the actual conditions. Following the report rendered, many local meetings were held with municipal officials, women's clubs and taxpayers, and talks were given before practically all service clubs in the valley. A striking pamphlet was published to show the deterioration and hazardous conditions in the stream. Following this arousing of sentiment an act was passed by the Legislature to authorize the Port Raritan District Commission to make an engineering investigation. A firm of engineers, employed to make the investigation, rendered a report setting forth calculations, recommended methods of treatment and costs. The condensed report was published and widely distributed. Again many meetings were held with elective and appointive officials, and the plans were discussed before a number of civic organizations. Since many of the municipal officials could not or would not come to some definite plan of procedure an appeal was made to the Legislature to appropriate funds to the State Department of Health for enforcement of the laws with respect to the pollution of the Raritan river. A field survey was made by the Department of Health. Following this the Counsel for the Port Raritan District Commission, Russell E. Watson, who had been the guiding spirit in the fight for the clean-up, was appointed deputy Attorney-General in the capacity of legal advisor and prosecutor. Based upon its findings, the Department of Health, in 1932, issued notices ordering the municipalities to cease pollution. The economic depression made it difficult to proceed and a two year extension was given. Shortly after the expiration of the extension the P.W.A. was organized by the Federal Government and financial aid became available.

It is clear in this case that the movement for a clean-up was instigated and carried forward by arousing public sentiment through a group of private citizens rather than by the efforts of municipal officials. The large number of letters, motions and legislative action would not have sufficed, however, if help from the P.W.A. had not been available to finance the projects.

The Elizabeth River. As early as 1902-03 the sewage of seven communities in the Elizabeth Valley was conveyed to a central point by a trunk sewer. Through the untiring effort of the consulting engineer who had built the original trunk sewer—Alexander Potter—the governing bodies of eleven municipalities entered into a joint contract in 1926 for the construction of a supplementary joint trunk sewer and a sewage plant to relieve the grossly polluted waters of the Arthur Kill. Some of the municipalities entering into the contract were partly located in the Rahway Valley. The supplementary trunk sewer was placed in operation in 1932 and the first contracts for the plant was let in 1931. Although 93 per cent of the sewers and plant had been completed in 1932, two of the eleven municipalities found themselves unable to sell sufficient bonds to complete their share of payments for construction. The project rested until 1935 when aid of the W.P.A. was made available. The plant was located in the City of Elizabeth, a non-member of eleven municipalities. Of interest, this scheme necessitated the change of the Home Rule Act, which was not accomplished without effort. In this instance the move-



The Somerville Plant. A Partial View Showing One of the Filter Equipped Clarifiers with One Arm Scraper Mechanism.



The New Brunswick Plant (from the Rear) Sits in the Center of the City. Employs Prechlorination and Chemical Precipitation Seasonally.

ment and success of the clean-up was due to the engineer and officials of the participating municipalities.

The Rahway Valley. For the reduction of pollution in the Rahway River a scheme similar to the Elizabeth Valley Joint Meeting was followed. Efforts by the consulting engineer and action of officials of nine municipalities resulted in the signing of a contract in 1928 for the design, construction, operation and maintenance of a trunk sewer and treatment plant. Actual construction of the trunk sewer was begun in 1929 and completed in 1931. Again the depression interfered and construction of the sewage treatment works was not started until the fall of 1935 when, with the assistance of the P.W.A., the cost of construction was financed in part by loans and grants to the several municipalities members of the Rahway Joint Meeting.

Types of Plants

It is of extraordinary interest that all plants built (large and small), are modern; several employing unusual machinery or processes which have come to the fore during the last few years. In Table 1 the processes and units are briefly summarized. In keeping with the progress in sewage treatment all plants have chemical laboratories, some of which are equipped for special chemical and bacteriological investigations as well as for routine analyses.

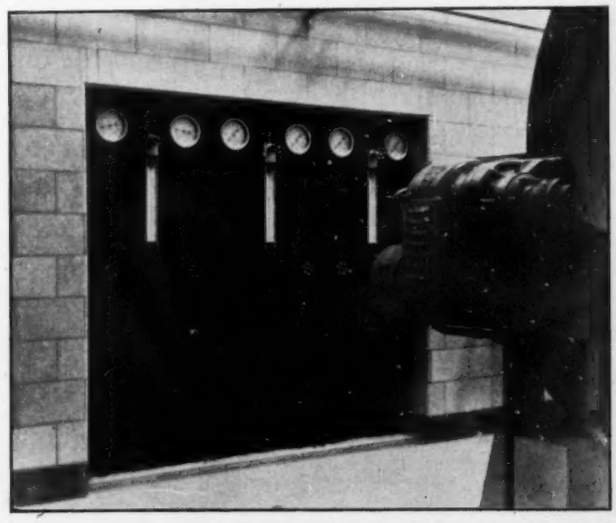
The general trend in present day sewage treatment is best illustrated by the fact that of the 13 new plants constructed, eight are equipped for chemical treatment. Some will be operated with chemicals throughout the year, while others will treat the sewage with chemicals during the summer season (May-October) only.

Rather than discuss these plants in detail, attention is called to some of the unique, unusual or interesting units or devices employed in the individual plants.

At the Elizabeth Joint Meeting plant the first large sludge scraping mechanism built in this country to use one blade, electrically propelled in a rectangular settling tank, shows the possibilities of this type of mechanism under actual operation. Another feature, new for the eastern part of the United States, is the picket-fence type thickening device in the sludge concentration tanks. The sludge, obtained from the settling tanks, ordinarily containing about 5 per cent solids, can be reduced to one-half of its original volume, or thereabouts, under suitable conditions and time in the concentration unit. Since the sludge produced by this plant is stored for 2 to 3 weeks and then barged to sea, reduction in moisture content is of considerable economic importance.

The Rahway Valley Joint Meeting plant has automatic washing and lifting of grit from the gritchamber, similar to that at the Elizabeth Valley plant. The multiple (two-stage) digestion units are the first large scale tanks of this type in New Jersey. The sludge is heated and most of the gas produced is evolved in the first tank. The gas is used for hot water heating of the tanks, heating of the building, incineration of screenings and lab-

The Highland Park Plant.



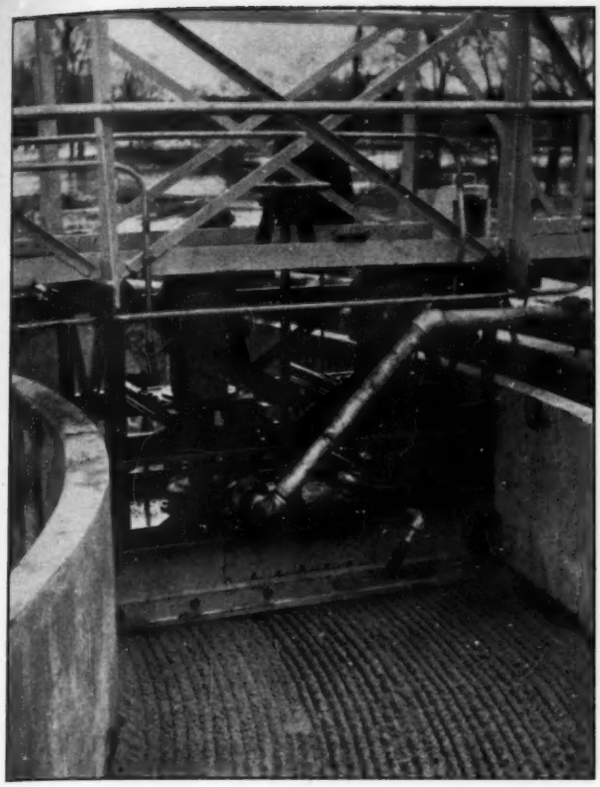
At the New Brunswick Plant. Novel Arrangement of Panel Chlorinator Built in Wall Recess.

TABLE 1

SUMMARY OF PROCESSES AND TYPE OF UNITS EMPLOYED—NEW JERSEY PLANTS

Place	Processes	Type of Units
Elizabeth Valley	Screening, grit collection, settling, sludge thickening, sludge barging, chlorination.	Automatic screenings and grit collection and removal, Mieder sludge mechanism, sludge thickening tank, sludge storage tanks, barging of sludge to sea, chlorinators.
Rahway Valley	Screening, grit collection, settling, digestion, sludge drying, chlorination.	Automatic screenings and grit collection, rectangular clarifiers, heated two-stage digestion with gas collection, covered sludge beds, grinding of sludge, chlorinators.
Raritan Valley: Raritan	Screening, flocculation, chemical coagulation, settling and straining, dewatering of sludge, drying and incineration, chlorination.	Mechanically cleaned screens, flocculators with mechanical agitators, automatic chemical feeders, circular clarifiers equipped with sand strainers and sludge scrapers, vacuum filtration of sludge, multiple hearth dryer with basket grate incinerator for sludge in combination with garbage, chlorinators.
Somerville	Screening, flocculation, chemical coagulation, settling and straining, dewatering of sludge, chlorination.	Mechanically cleaned screens, flocculation with mechanical agitators, automatic chemical feeders, clarifiers equipped with sand strainers and sludge scrapers, vacuum filtration, land disposal of sludge cake, chlorinators.
Manville	Settling, digestion, sludge drying, oxidation, secondary settling, chlorination.	Mechanically cleaned settling tanks, separate sludge digestion, glass covered sludge beds, circular trickling filters with rotary distributors, rectangular sedimentation tank, chlorinators.
Bound Brook	Screening, flocculation, chemical coagulation, settling, digestion, sludge drying, chlorination.	Mechanically cleaned screens, rectangular clarifiers with continuous sludge removal, flocculators with mechanical agitation, multiple stage digestion, glass covered drying beds, chlorinators.
Middlesex Borough	Screening, flocculation, chemical coagulation, settling, digestion, sludge drying, chlorination.	Mechanically cleaned screens, round clarifiers with continuous sludge removal, flocculators with mechanical agitation, separate sludge digestion, glass covered sludge drying beds, chlorinators.
New Brunswick	Screening, flocculation, chemical coagulation, settling, digestion, sludge dewatering, chlorination.	Mechanically cleaned screens, automatic chemical feeders, rapid mixing, flocculators with mechanical agitation, square clarifiers with rotary sludge collectors, heated separate sludge digestion with gas collection, vacuum filtration of sludge, built-in chlorinators of panel type.
Highland Park	Screening, settling, digestion, sludge drying, chlorination.	Mechanically cleaned screen and screenings shredder, chain-belt clarifiers with mechanical sludge removal, separate sludge digestion and gas collection, glass covered sludge drying beds, chlorinators.
Raritan Township	Screening, settling, digestion, sludge drying, chlorination.	Mechanically cleaned screen, rectangular clarifiers with mechanical sludge removal, separate sludge digestion, glass covered sludge drying beds, chlorinators.
South River	Screening, grit removal, flocculation, chemical coagulation, settling and straining, dewatering of sludge, chlorination.	Mechanically cleaned screen and grit removal, flocculation by air diffusion, chemical feeders, circular clarifiers equipped with mechanically cleaned sand strainers, vacuum filtration of sludge, land disposal of sludge, chlorinators.
Sayreville	Screening, grit removal, flocculation, chemical coagulation, settling and straining, dewatering of sludge, chlorination.	Mechanically cleaned screen and grit chamber, air flocculation, chemical feeders, clarifiers with sand strainers, vacuum filtration of sludge, land disposal of sludge, chlorinators.
Metuchen	Screening, settling, digestion, oxidation, secondary settling, sludge drying, chlorination.	Coarse screens, rectangular clarifiers with continuous sludge removal, separate digestion, circular trickling filter with rotary distributor, final clarifiers, old sand beds for sludge drying, chlorinators.
Woodbridge	Removal of four old settling tanks.	Plans to divert sewage to Perth Amboy.
Perth Amboy	Screening, flocculation, chemical, coagulation, settling and straining, dewatering of sludge, chlorination.	Mechanically cleaned screens, flocculation by air, chemical feeders, circular clarifiers with magnetite strainers, vacuum filtration of sludge, land disposal of sludge, chlorinators.
Keyport	Screening, settling, digestion, sludge drying, chlorination.	Coarse screen and grit chamber, rectangular clarifiers, separate digestion, glass covered sludge beds, chlorinators.
Flemington	Screening, settling, oxidation, sludge drying, secondary settling, chlorination.	Screens, settling units, trickling filters, settling tanks, sludge digestion, sludge drying beds, chlorinators.
Princeton	Screening, settling, digestion, oxidation, sludge drying, chlorination.	Coarse screens, rectangular settling tanks, separate sludge digestion, sprinkling filters, glass covered sludge beds, chlorinators.
Plainfield	Screening, settling, digestion, oxidation, secondary settling, sludge drying, chemical treatment, chlorination.	Coarse screens, automatic grit removal, fine screen, Imhoff tanks converted to rectangular settling tanks with mechanical sludge removal, trickling filters, chemical treatment, flocculation and settling of trickling filter effluent, heated separate sludge digestion, spray-dryer for sludge, chlorinators.

NOTE—The Princeton and Flemington plants, already existing, are recently built plants. Plants remodeled or essentially rebuilt are those at Plainfield, Keyport, Metuchen.



A Close View of One of the Automatically Cleaned Sand Strainers—This One at the Raritan Plant.

oratory use. Provision is made to grind the digested (dried) sludge for agricultural, floricultural and horticultural uses.

In the Raritan Valley, the plant of the town of Raritan is equipped with one of the new multiple hearth driers and incinerator for the combined disposal of screenings, sludge and garbage. The clarifiers present something new, in that they are equipped with mechanically cleaned sand strainers (filters) to remove the finely divided material before the effluent is discharged. These strainers, suspended within the tanks, are cleaned automatically by a stream of water or purified effluent, the dirty water being pumped back to the settling tank as the washing unit passes over the sand. This plant is perhaps the most completely equipped in the Raritan Valley for the production of a high degree of clarified effluent. In common with other modern plants this rather small plant will require capable operation by a qualified personnel.

At Somerville, in addition to chemical treatment, the plant is equipped wtih clarifiers and sand strainers similar to the Raritan plant, but the sludge produced is dewatered on a vacuum filter and the cake disposed of on land. Land disposal of chemically treated sludge has been practiced elsewhere in New Jersey with success, where the sludge contained industrial wastes.

The Manville plant provides for biological oxidation of the settling tank effluent as well as for modern separate sludge digestion. The circular trickling filters, equipped with rotary distributors, are unique in this section of the State. The sludge beds are glass covered and the sewer and much of the plant piping consists of asbestos-cement "Transite" pipe.

The Bound Brook and Middlesex Borough plants are similar, in respect to chemical coagulation and mechanical flocculation of the sewage, but the Bound Brook plant has multiple sludge digestion units and the Middlesex Borough plant single stage separate digestion. Both plants boast glass covered sludge drying beds.

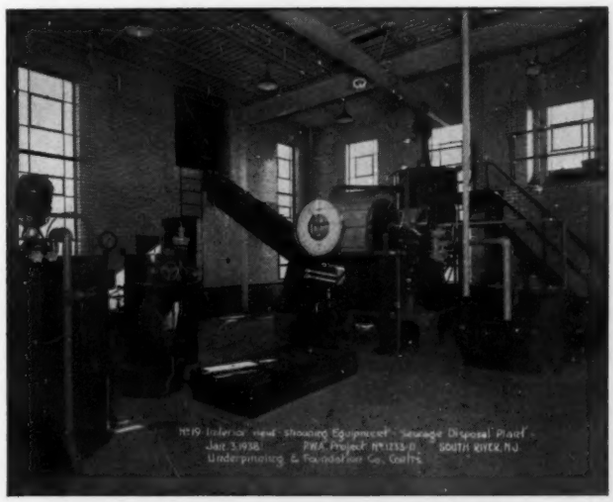
At New Brunswick, in addition to mechanical flocculators the plant is equipped with a rapid (flash) mixing device for efficient distribution of the chemicals through the sewage before flocculation. Of interest is the method of vacuum dewatering of digested sludge. Vacuum filtration of sludges produced by chemical coagulation and the activated sludge process has become rather general practice, but dewatering of digested sludge on vacuum filters is new for this State. Another novel feature at this plant are the large Pardee panel-type chlorinators, which are built into the wall between the filter room and chemical dosage room.

In the Highland Park plant, an unusual piece of equipment is the screenings shredder. Mechanically removed, the screenings at intervals are shredded and returned to the sewage. Also, the method of baffling the mechanically cleaned clarifiers is of particular interest to operators. The board baffles are placed several feet away from the inlet of the rectangular Chain-Belt clarifiers. Such baffling does not allow the sludge scraper or scum removal device to reach the inlet section of the tank set off by the baffle boards. The result is that scum accumulating on top of the sewage in this section of the tank must be removed by hand or, else, must be washed through the baffles.

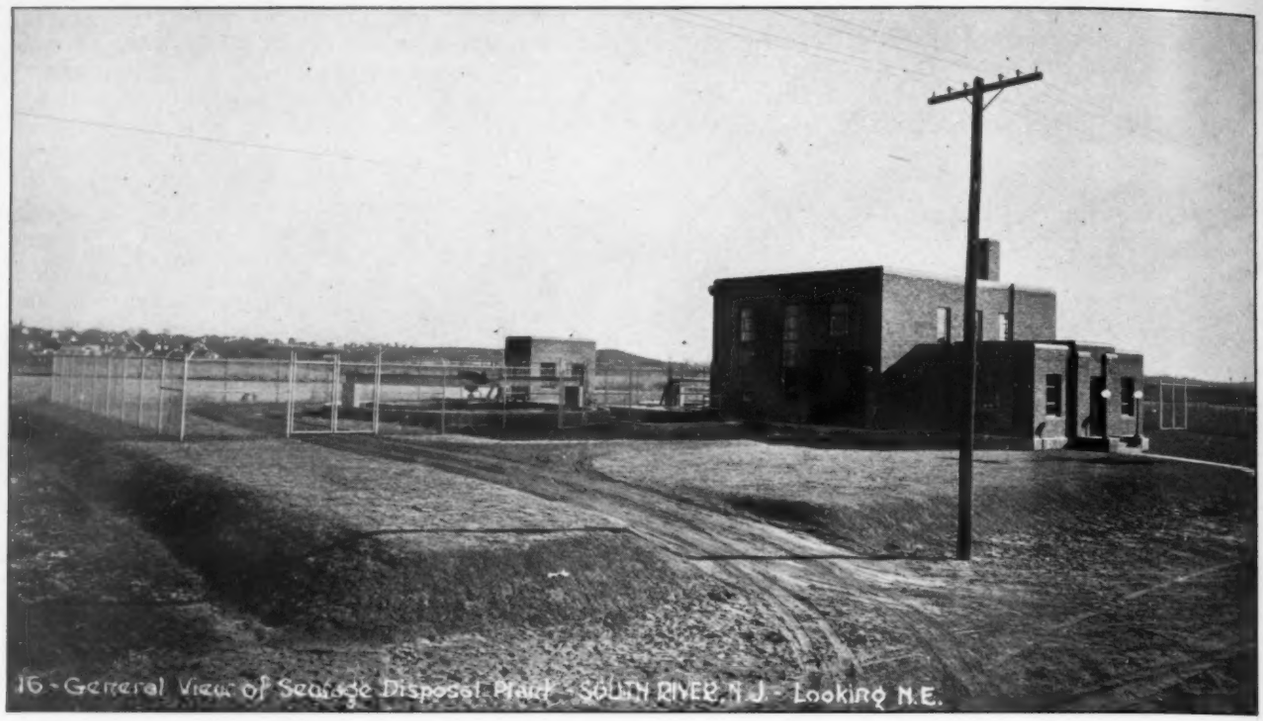
At Raritan Township the plant is, in general, similar to the Highland Park plant.

The South River and Sayreville plants are provided with circular clarifiers equipped with mechanically cleaned sand strainers of the type used in Somerville. These two small plants are unusually well equipped with mechanical devices. The extent to which modern mechanical operation of sewage works equipment has progressed may be illustrated by the fact that the South River plant, with a capacity of but 750,000 gallons daily, uses not less than 28 motors of different sizes—mostly small units, of course. Also, of interest in these two plants is the fact that flocculation of the sewage is accomplished by air diffusion.

The Perth Amboy plant, first of the new plants in the lower Raritan Valley and the pioneering modern chemical coagulation plant in the Eastern part of the United States, is still the outstanding example of plants in operation employing circular clarifiers equipped with automatically cleaned magnetite strainers. These strainers have proved to be successful and comparisons with the



The South River Plant—Showing Chemical Feeders, Chlorine Scales,, Vacuum Filters.



The South River Plant.

new sand strainers at nearby plants will be of unusual interest on the basis of costs, operation and performance.

Construction Costs

The cost of construction varies materially for the different plants. In general, the larger the plant the lower the per capita cost. However, amongst the smaller plants considerable variation in per capita cost is noticed. In some cases this is due to the type of treatment provided. For instance, the highest cost per capita amongst the smaller plants is for Raritan. Here the sludge is to be dried and incinerated together with garbage. A tabulation of the cost per capita figures, based upon design and connected populations and the cost per million gallons design capacity (Table 2), with the exception of Raritan, shows that these modern small plants (designed to treat from 0.6 to 2.0 mgd.) cost from $10.65 to $15.90 per capita, based upon the design population. On the basis of present connected population the cost varies from $11.35 to $27.10 for the construction of the plant only. For obvious reasons, sewers, boosting stations, etc., have been left out in these calculations. As soon as the plants become larger, (9 to 10 mgd.) the cost per capita, on the basis of design population and connected population, are reduced to between $7.20 and $9.05 and $8.40 to $9.40, respectively. When several communities are combined and the sewage flow increases, the cost is materially less. The Rahway Valley plant is designed to handle 25 mgd. flow through a part of the plant and a population capacity of 75,000 is provided for in another part of the plant. The cost, on the basis of the design population, is $4.00 per capita; for the present connected population it is $6.15. The still larger Elizabeth Valley plant, with a connected population of 420,000 in the near future, on the basis of the connected population cost only $2.83 per capita.

A comparison of the relative cost of construction of the various plants, based upon the cost per million gallons design capacity, is perhaps more illuminating than the presentation of any other figures. Keeping in mind that there is some variation in the degree of treatment to be accomplished (and that no sewers, boosting stations, land or other costs are included), the picture is of

TABLE 2—CONSTRUCTION COSTS PER CAPITA AND PER M.G.D. CAPACITY

(Exclusive of sewers, pumping stations, land, etc.)

Location	Flow Design M.G.D.	Cost Per Capita: Design Population	Cost Per Capita: Connected Population	Population: Design	Population: Connected	Cost Per M. G. (design)
Elizabeth Valley	100.0[1]	1.19	2.83	1,000,000[1]	300,000[2]	$11,880
Rahway Valley	25.0[3]	4.00	6.15	125,000[3]	65,000	20,000[4]
Raritan Valley:						
Raritan	1.5	32.25	42.60	6,600	5,000	148,500
Somerville.	1.9	15.60	17.50	10,000	8,900	82,240
Manville	0.8	10.30	13.80	8,000	6,000	103,000
Bound Brook	1.2	14.25	22.25	12,000	8,000	148,500
Middlesex Borough	0.8	15.20	27.10	8,000	4,500	153,700
New Brunswick	9.0	7.20	8.40	40,735	35,000	32,550
Highland Park	2.0	10.10	14.60	13,000	8,700	67,300
Raritan Twp.	0.6	15.90	19.10	6,000	5,000	95,500
South River	0.75	10.65	12.50	12,000	10,300	177,000
Sayreville	0.75	15.55	....	8,000	.....	166,000
Metuchen*	1.1	10.50	16.15	8,800	5,750	83,320
Woodbridge	0.8[5]	1.86†	2.47†	8,000	6,000	.....
Perth Amboy	10.0	9.05	9.40	46,000	44,000	41,600

*Reconstruction; †estimated; [1]two hours detention; [2]near future 420,000; [3]digestors for 75,000 people; [4]equated, settling for 25 m.g.d.; [5]for sewer and pumping to Perth Amboy plant.

Note—Plants recently built or remodeled on tributaries of the Raritan River include Flemington, Plainfield and Princeton. The plant at Keyport, located on the Raritan Bay, has recently been remodeled.

TABLE 3—PURIFICATION ACCOMPLISHED
(Average results for July to November, 1937)

Location	Suspended Solids Raw Sewage p.p.m.	Suspended Solids Removal Pct.	B. O. D. Raw Sewage p.p.m.	B. O. D. Removal Pct.
Elizabeth Valley	178	67[3]	198	37[3]
Rahway Valley	175	71[4]	112	40[4]
Perth Amboy	255[1]	84	230	63
	222[2]	75	243	34
New Brunswick	174	55[5]	158	36[5]

[1]Chemical precipitation June-Sept.; [2]plain sedimentation, plus magnetite strainers; [3]minimum of 4 hours detention; [4]minimum of 6 hours detention; [5]operating without chemicals.

unusual interest. Tabulating the average cost for plants with capacities of from 0.6 to 1.2 mgd., and comparing this with the average cost for plants of slightly higher capacity and with plants of considerably larger capacities, we find the following:

M. G. D. Capacity	Cost Range	Average
0.6- 1.2	$103,000-177,000	$140,600
1.9- 2.0	67,000- 82,200	74,600
9- 10	32,500- 41,600	37,000
25	.....	20,000
100	.....	11,900

In these calculations, again the sewage plant of Raritan has been excluded because of the added cost involved in combining garbage destruction with sewage treatment.

Effective Purification

The purpose of the construction of the plants is to abate the pollution in the different rivers. It is therefore of interest to look into the degree of removal of sludge forming substances and the reduction in oxygen demand loadings accomplished by those plants which have been in operation a sufficient length of time. Taking the results from four plants, three of which were placed in operation last year, the average results over the period July to November, 1937, show rather high suspended solids removal and appreciable reduction in oxygen demanding substances. (Table 3.) The average removal of suspended solids by the different plants varied between 55 and 75 per cent, while the reduction in oxygen consuming materials varied from 36 to 40 per cent. In general the degree of purification of the small plants will not be materially higher, although some of these plants equipped with effluent strainers will produce effluents which may contain from 10 to 15 per cent less suspended solids, and have less oxygen demand values.

From the standpoint of cleaning the rivers, some figures on the amounts of sludge removed and the reduced load on the rivers in terms of oxygen, or clean water equivalent, may convey to many a clearer picture of what has been accomplished. The Joint Elizabeth plant removes daily (with increasing connections) an estimated minimum of 12,000 cu. ft. of wet sludge. The sludge and other oxygen demanding substances removed is equivalent to the supply of about 21,000 pounds of oxygen. Putting it differently, this is equivalent to the oxygen available in some 200 to 300 million gallons of clean water daily to theoretically accomplish purification by the old dilution scheme. Similar calculations for the Rahway Valley show that some 3,600 cu. ft. of wet sludge is removed daily. The reduced load on the oxygen supply of the river amounts to some 4,200 pounds, which is equivalent to between 42 and 55 million gallons of clear water added to the stream.

When all the plants are in operation in the Raritan Valley calculations (on the basis of connected populations) indicate that over 125 tons of wet sludge will be taken out of the river daily. The oxygen requirements will have been reduced by 8,750 pounds daily, or the equivalent of the oxygen content in 90 to 120 million gallons of clean water daily added to the stream.

What About Industrial Wastes?

In many instances, particularly in the Raritan river, industrial wastes will likely still be discharged for some time to come into the rivers. In the Raritan river the volume of industrial waste is at least the same as the total domestic sewage from all communities. Some of these industrial wastes produce appreciable quantities of sludge, while others have high oxygen demands, coloring matter and in some instances poisons. Fairly rapid progress is being made to alleviate these sources of pollution, but until this is accomplished the cleaning-up program will not have been finished.

Summary

In summarizing the alleviation of stream pollution on a systematic scale in the Raritan, Elizabeth and Rahway rivers, as basin-wide projects, it may be said that:

1. Great strides have been made in the clean-up as exemplified by the fact that 60 per cent or more of the sludge producing elements formerly discharged into the rivers is retained, and that the load on the rivers is decreased to the equivalent of the oxygen present in between 330 and 475 million gallons of clean water daily added to these streams.

2. The cost of construction of the treatment plants increases with the decrease in size of the plants and is in no wise in proportion to the degree of purification accomplished.

3. That there appears considerable variation in construction costs, even for the same type of plant of approximately the same size.

4. That treatment of industrial wastes is required, especially in the Raritan River basin, before the clean-up is completed and the present investment in sewage treatment plants will bear full fruit.

Acknowledgment.—This paper was presented before the Annual Convention of the New Jersey Association of Professional Engineers, January 15, 1938.

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U. S. PIPE CITED FOR DISTINGUISHED ADVERTISING

At a dinner held at New York City's Waldorf Astoria, February 24th, the Annual Awards for Advertising Excellence were presented by the Committee for Annual Advertising Awards. Three awards are made annually to advertisers represented in the leading national magazines, both popular and technical, from *"Fortune"* to *"Water Works and Sewerage."*

Of the three certificates of Awards "for the most distinguished advertising campaigns of 1937" United States Pipe and Foundry Company was the recipient of one, in recognition of its industrial advertising of Cast Iron Pipe, featuring performance of the product. Especially proud is U. S. Pipe of this recognition, which was received in competition with thousands of campaigns that appeared in such national magazines as *"The Saturday Evening Post," "Time," "Fortune"* and others.

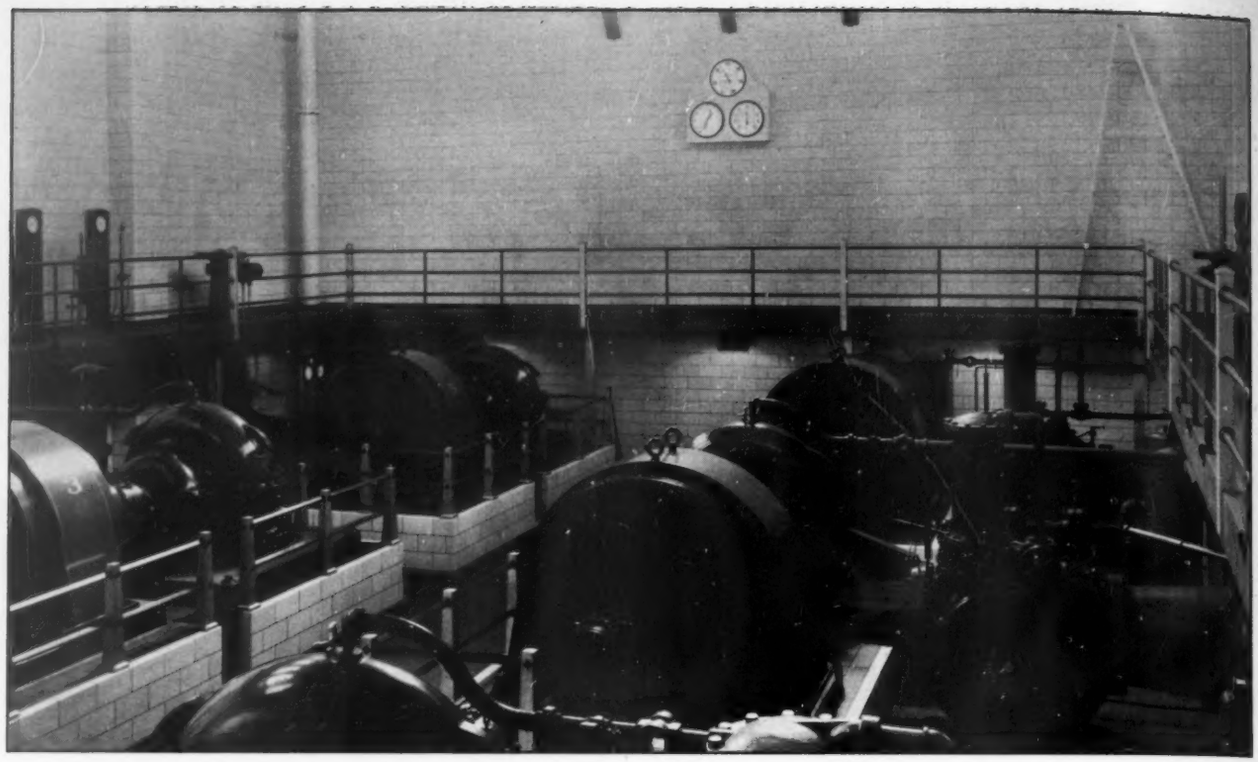

Fig. 1—Cermak Pumping Station Showing 3-Dial Gauge on Wall and Compact Master Timer Directly Beneath. Under the Operating Gallery the Latter is Barely Visible.

FLOW SUMMATION AT CHICAGO'S CERMAK STATION

By CHARLES G. RICHARDSON*

Providence, R. I.

The Author

TO WATER works engineers perhaps the best known and one of the most important of all of Chicago's twelve pumping stations is the new Cermak Station, located on West Harrison Street, close to the loop district. It was built to meet the increased water consumption and to assist in maintaining the required pressure in the general distribution system. Like the other stations of the city, it receives its water through an under-street tunnel extending to an intake crib several miles off the shore of Lake Michigan. As is usual with the Bureau of Engineering of Chicago, particular emphasis was placed on quality of structural design and high efficiency of equipment performance. This important station is capable of delivering water up to a maximum of 300,000,000 gallons per day by six 50 m.g.d. motor-driven centrifugal pumps.

The discharge from each pump is measured by a 42-in. Builders Iron Foundry Venturi Meter, equipped with Type M Venturi Register-Indicator-Recorder. The latter are distributed around the mezzanine gallery of the pump room. Each is interconnected with a barometric type rate indicating manometer.

Until a few months ago, it was the duty of one of the operating engineers to read each meter every hour and to report the total pumpage rate to the chlorine room supervisor for comparison and resetting, if necessary, of the chlorine dosage. This had obvious disadvantages: among them the long distances to be traveled, the total pumpage computed, averaged and reported twenty-four times per day; more importantly, some emergency condition might suddenly arise with definite danger of chlorine over-treatment or under-treatment, especially the latter. For instance, the rate of output of the station might be suddenly increased due to a fire within the business loop or a pipe line break; fish accumulate on the intake screen; a main valve inadvertently be closed, or some failure occur in pump performance. Any of these might not become known to the chief engineer or the chemist for a maximum of sixty minutes after occurrence. It was, therefore, highly desirable that summation and centralization at convenient points of the total rate of discharge from the six pumps be provided if possible.

Chronoflo Installed

The problem was put up to the meter manufacturer, with the result that now there have been in successful service at Cermak Station for several months automatic indicating and recording instruments which continuously totalize the rate of station output.

*Chief Engineer and Sales Manager, Builders Iron Foundry.

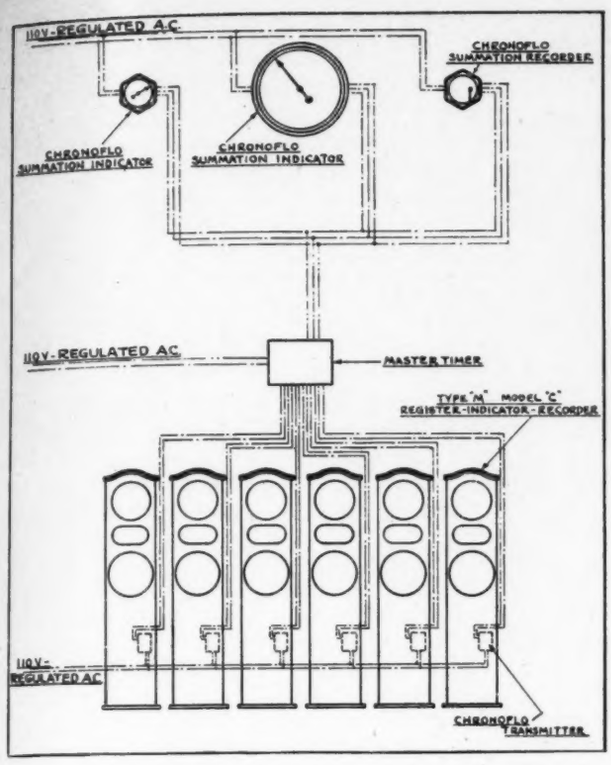

Fig. 2—Diagrammatic Arrangement of Summation Records Flow Indicators in Cermak Station, Chicago.

The principle and elements of the Chronoflo Meter are employed in the solution. Inside the case of each Type M Venturi Register is the usual long vertical lever moving in exact proportion to the rate of flow. A Chronoflo Transmitter (Figs. 3 and 4) is mounted adjacent and connected to this lever by a link in such a manner that the cam-shoe arm of the transmitter is thereby positioned. The "linear" cam which the shoe contacts is revolved continuously, once every 15 seconds, by a synchronous motor. Through a rocker bar, the cam shoe (as it "rides" or "falls off" the cam) moves a permanent magnet out or in to actuate an electric mercury contact

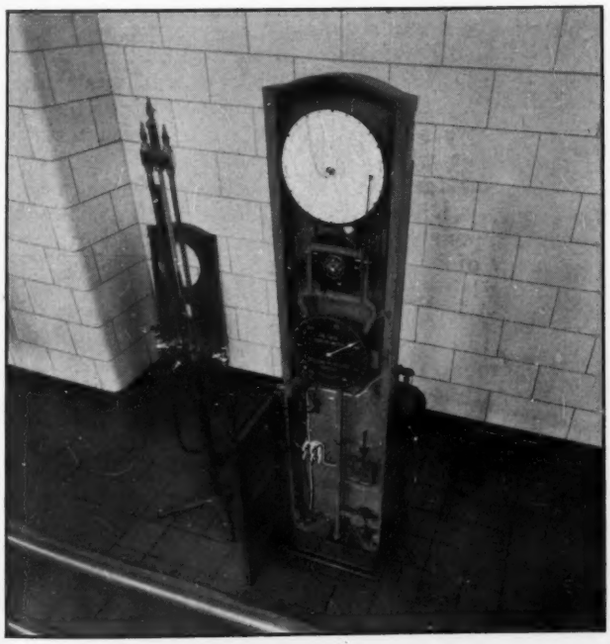

Fig. 3—Type M Register with Chronoflo Transmitter in Case Below (Indicated by Arrow).

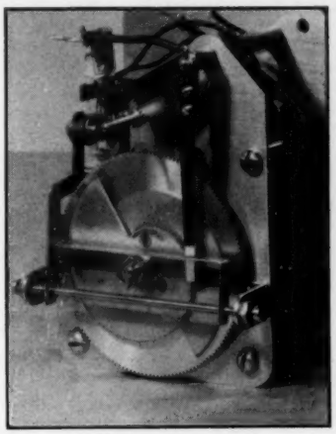

Fig. 4—The Chronoflo Transmitter (See Location in Fig. 3).

switch. The length of time per cam revolution which the shoe rides upon the cam is in direct proportion to the rate of flow through the Venturi Meter as reported by the Type M Register. It also determines the time duration of electric current which is sent to the receiving instrument. Altogether there are included for the six meters the following units:

a. Six Chronoflo Transmitters, one for each of six Type M Registers.

b. One Master Timer.

c. Three Chronoflo Receivers, consisting of one 24-in. illuminated Rate Indicator, one 10-in. Rate Recorder, and one 10-in. Rate Indicator.

The Master Timer will be noticed just under the mezzanine floor, beneath the three-dial gauge on the pump room wall.—Fig. 1.

The several receivers will be easily recognized from the illustrations: the main illuminated indicator is the upper dial of the instrument on the wall of the pump room; the recorder on the panel is located in the chief operating engineer's alcove; the second indicator is visible through a window in the chlorine room. Each of these instruments shows continuously the *total* rate of discharge of the six pumps in millions of gallons per day. Inside each Chronoflo Receiver are dual magnetic clutches revolved in opposite directions, through bevel gearing, by a synchronous motor. The arrangement is

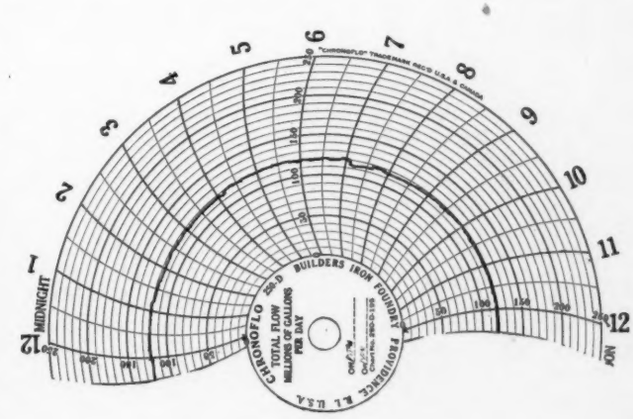

Fig. 5—Section of Chart.

such that the clutches are alternately magnetized through the receipt of current from the Master Timer, thus repositioning the indicator dial hand or chart pen if there has been any change in the total flow rate.

The diagrammatic sketch (Fig. 2) will clarify the relative position and electric interconnection of the three main units; the Type M Instruments, the Master Timer and the Receiver Instruments. The Chronoflo circuits are of the two-wire order. Briefly, the central Master Timer consists of two series of cam operated switches driven by synchronous motors. Its function is to receive, in sequence, the time duration signals from the Type M Transmitters and send them in a definite order

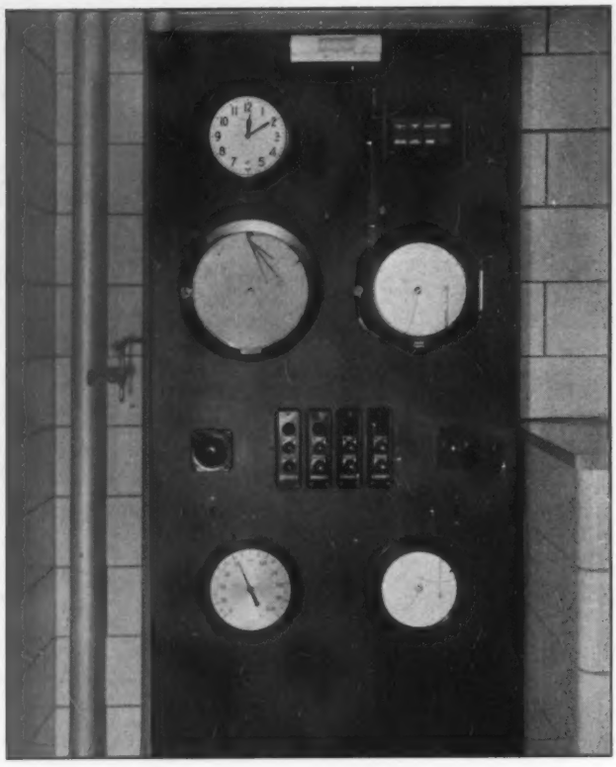

Fig. 6—Chronoflo Receiver, Indicating and Recording Panel.

to the clutches of the Receiver Instruments. The whole is so timed that once every three minutes the readings of these instruments are corrected or confirmed. A long series of careful comparisons has shown that the totalized rates of the three Summation Receivers agree within 1 per cent of the total rates shown by the six individual receivers. The latter also have the usual counterdials which are read once per day to obtain total gallons pumped. A section of actual chart record from the Summation Recorder is reproduced by Fig. 5.

It seems amply demonstrated that the Chronoflo summation equipment at Cermak Station is serving a very useful purpose in rendering unnecessary hourly rounds of inspection, in giving *immediate* notice at convenient points in the station of any abnormal operating conditions and, further, in assuring efficient chlorination control at all times.

In general, it may be added that the Chronoflo system is so flexible that both flow rates and totals (if desired) can be integrated from a large number of individual meters, whether of the same or of different sizes and capacities. If such meters are already installed, transmitting attachments can be used as at Cermak. As many secondary instruments can be hooked in as may be required, and these can be placed in the same building as the primary units, or in adjacent buildings or miles away by using local telephone or fire alarm circuits. In addition to flow rates, the Receiver Instruments can carry other information, such as level in distant water tanks, position of large valves, or pressures at important points in main pipe lines. They can also provide various types of control, such as the starting and stopping of distant pumps and other automatic supervision.

▼

CLIMATIC RESEARCH AND FLOOD CONTROL.—Flood control by geographic methods may be the outcome of climatic research being carried on in the Muskingum Valley of Ohio by the United States Soil Conservation Service, which has assembled much new material concerning the relationship of rainfall to run-off and of the effects of land use on floods. In the Muskingum Valley Studies, a WPA project, with the Muskingum Valley Watershed Conservation District cooperating, covering 8,000 square miles, 500 self-recording rain gauges and an equal number of instruments for measuring temperature, relative humidity, and wind velocity and direction have been installed.

▼

A CROSS CONNECTION WITH A VENGEANCE

By M. C. SMITH

Engr. of Water and Electricity, Richmond, Va.

Much has been written of the importance of avoiding the danger of "cross-connections." Recently there occurred a near tragic example of the greater need for care to avoid this danger. In Virginia, contiguous to a large city, there is a suburban area which operates a public water supply distribution system, under the authority of its charter as a Sanitary District. The District purchases water from the adjoining city at wholesale for distribution through meters to consumers residing within its area.

The practice of making connections has been the following: When a new service is to be installed, a plumber is employed to run the service from the building through to the main. The District would then engage the city supplying the water to use its equipment and its workmen to make the main tap, install the corporation cock, and connect to the service line previously laid by the plumber.

Recently the city's force was called to make such a tap into a six-inch cast-iron main which had been exposed by the plumber. When the work was completed, the city's workmen had not much more than left the job when a call came to the Water Department complaining that the pressure was "lousy" and that the water smelled worse. Investigation showed that the "water" was in reality sewage! (Other means than smell and taste were used to establish this strange truth.)

The Explanation

The home being connected was on a hill-side which sloped away from a trunk sewer running parallel to the residential development at the top of the hill. Consequently sewage from the development was collected at the foot of the hill and pumped up into the trunk sewer. Between the pump and trunk sewer a six inch cast-iron pipe was used. By coincidence it paralleled within a few feet the six inch cast-iron water main of the Sanitary District. The plumber knew nothing of the sewer pumping main; neither did the city's workmen know of its existence.

Too bad! but none was to blame. Fortunately, the pressure *was* "lousy" and the smell was bad! It was necessary to dismantle the plumbing system, to remove all washers and packing, and to heavily sterilize each separated part and the pipes with concentrated "HTH" solution. This was successful after several days' effort; but such a thing should not be possible. Perhaps all sewer pipes under pressure should be required to have a positively identifying exterior, possibly knobs of such design that a tapping machine could not be used even if a moron failed to realize the meaning of the peculiar surface. Aside from being a startling case of "what might have been"—I pass this story along for what it may be worth in the future development of sewerage force mains and water works records of their location and sizes.

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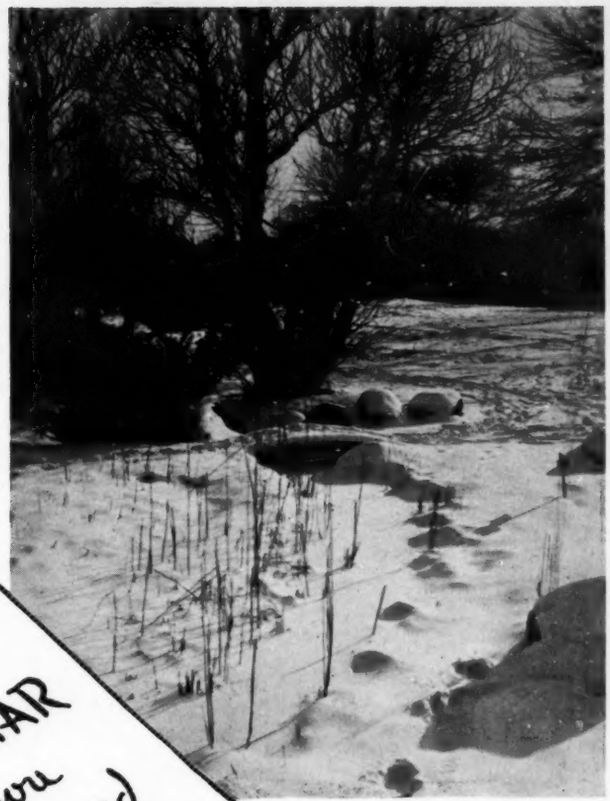

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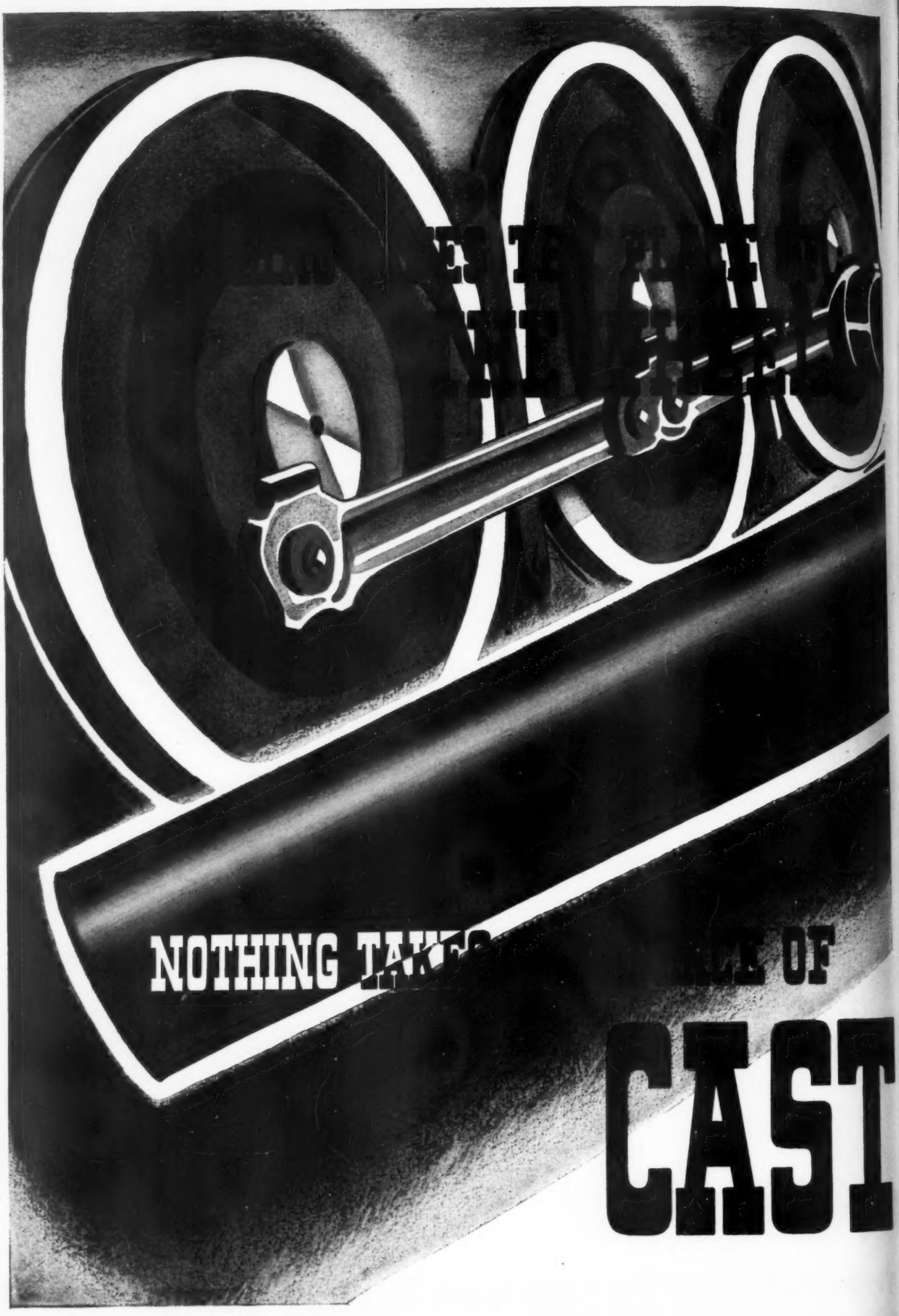
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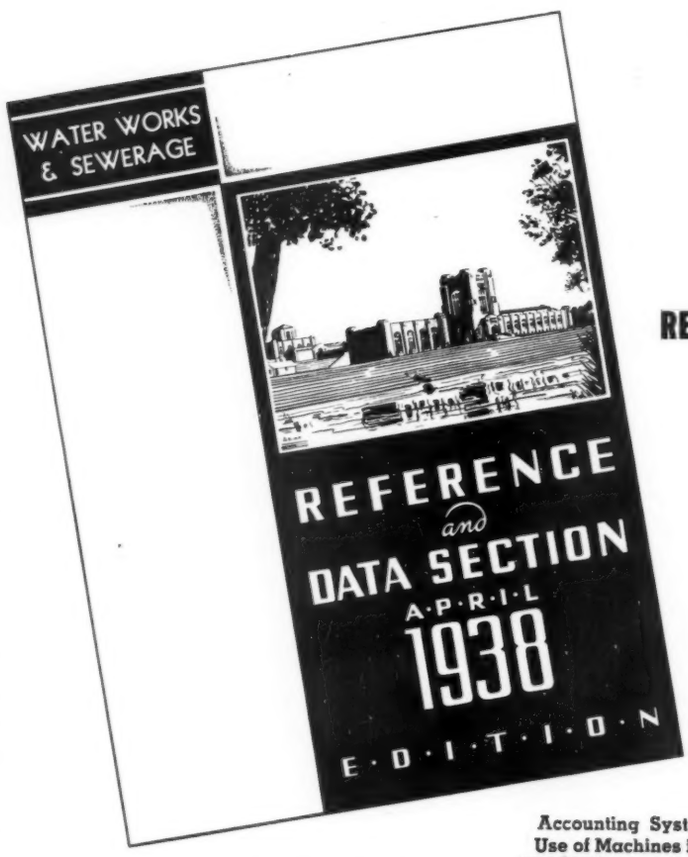

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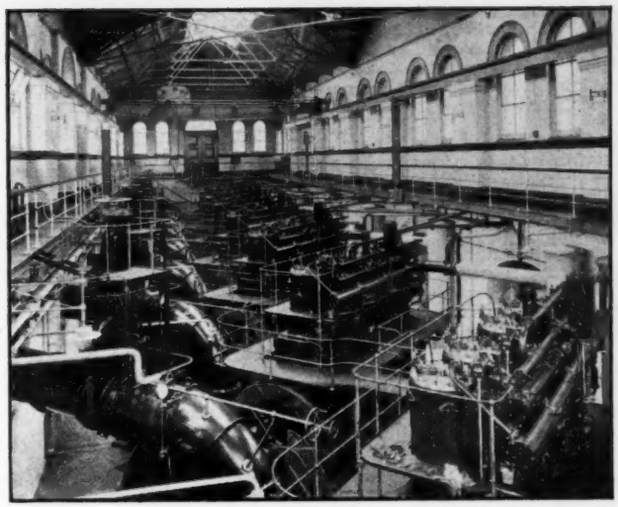


London Main Drainage Main Storm Water Pumps. Driven by Seven 500/600 H.P. Gas Engines Using Town Gas at Abbey Mills; Similar Sets at Hammersmith. Capacity of This Station 700 Tons/Min. at 40 Ft. Head.

MAIN DRAINAGE OF LONDON

By JOHN D. WATSON

Consulting Engr.,
Ruislip (Middlesex), England

THE recent opening of the Ward's Island plant as a step towards ending the pollution of the waters around New York calls to mind similar conditions which existed in London before the main drainage system was completed, though it will no doubt surprise many readers of these columns to learn that this vast scheme which today serves a population of some 6½ million actually existed in much its present form over 60 years ago.

The term London, except to those intimately acquainted with this city, is quite vague. Actually the City of London is barely one square mile in area and has but a negligible resident population. But, Greater London as it exists today, and coming within the Metropolitan Police area and served by the electric railways, is considerably larger than that shown on the plan in Fig. 1 though that is roughly what is served by the drainage system controlled by the London County Council and approximately

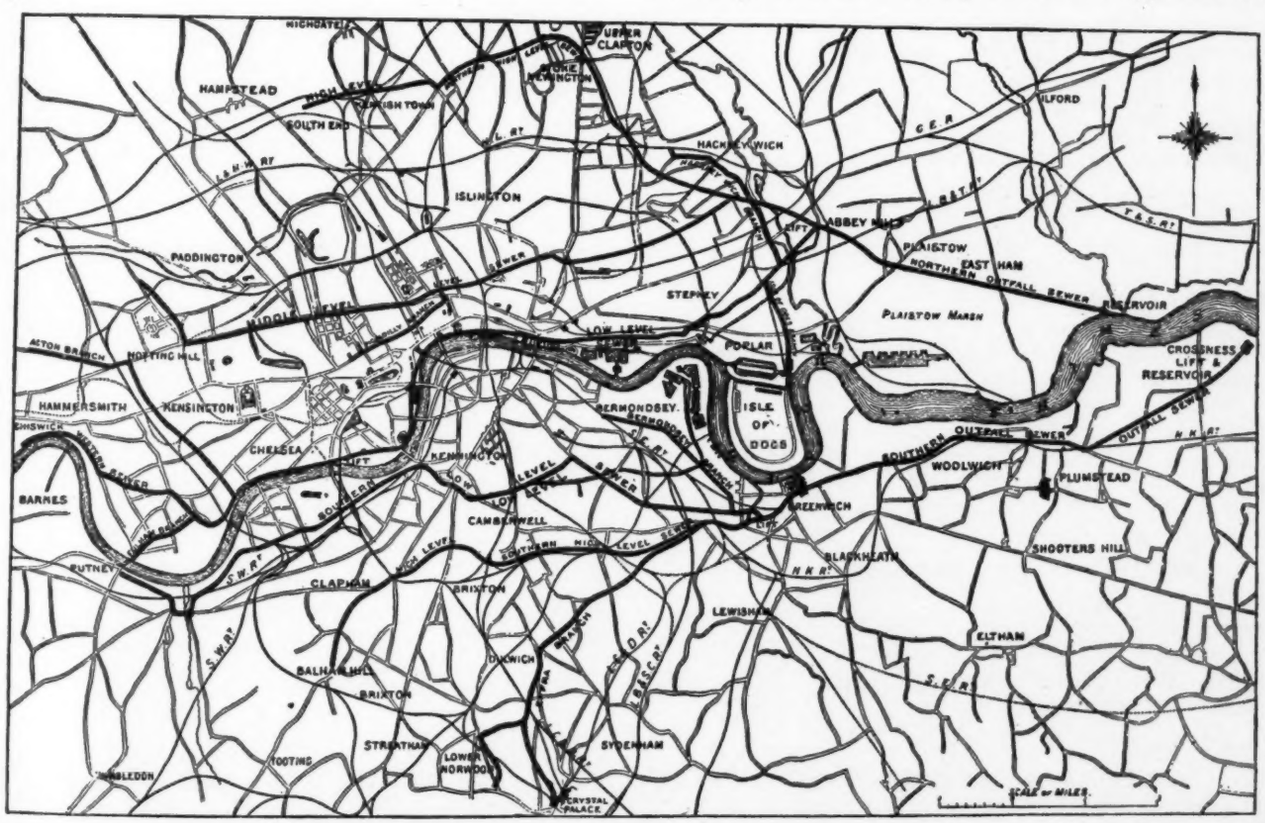


Fig. 1—London Main Drainage. Map Showing Lines of Main Sewers and Main Pumping Stations at Abbey Mills, Deptford, Chelsea, Hammersmith and Crossness.

that supplied with water by the Metropolitan Water Board. It embraces a number of Boroughs such as Holborn, Finsbury, Westminster, Southwark, to name only a few. These are local government bodies, responsible for public health in general and the roads and streets within their own areas, but in the middle of the last century some attempt was made towards solving the drainage problem by the old Commissioners of Sewers. Later there came into being the Metropolitan Board of Works armed with considerable powers which later on became the London County Council.

The London County Council

Apart from the fact that the old water companies have been united in the Metropolitan Water Board and the County Council tramways system has passed into the control of the electric railways, along with the buses from the original companies which operated them, the London County Council, popularly known as the "L.C.C." is the controlling body for everything here, except the river and dock system which is administered by the Port of London Authority, otherwise the "P.L.A." In common

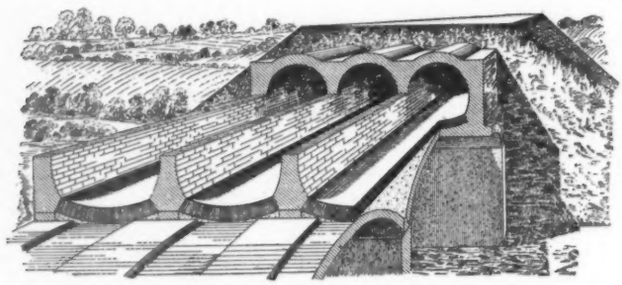


Fig. 2—Triple Northern Outfall as Originally Built. Has Now Two Additional Lines of the Same Form Built Alongside.

parlance the L.C.C. is a rating authority, that is to say it has powers to collect local taxation, which it does in no light manner. Armed with this power, as its predecessor was before it, there has been no difficulty in finding the 4½ million pounds or so which the original drainage scheme cost, nor the money for its effective maintenance and considerable enlargements as time has gone on.

Design of London's Drainage Systems

As might be anticipated, prior to construction of the six main lines of sewer and the two outfalls sewage gravitated to the Thames, often through covered in watercourses or at the best by very roughly constructed sewers. The tidal conditions not only blocked them and caused extensive flooding, but it caused the crude sewage

Section of Sewers.	Length of Sewers.	Area served.	Dimension of Sewers.	Fall per Mile.
	Miles.	Square miles.		
NORTH SIDE OF THE THAMES.				
High Level	7	10	4 ft. diam. to 9½ ft. × 12 ft. diam.	14 ft. to 74 ft. at top, 4 ft. to 3 ft. at bottom
Middle Level	9½	17½	4½ ft. × 3 ft. to 10½ ft. diam., and 9½ ft. × 12 ft. at outlet.	17 ft. at top to 2 ft. at bottom.
Do. Piccadilly Branch	2	—	4 ft. × 2 ft. 8 ins.	4 ft.
Low Level	8¼	11	6¾ ft. to 10½ ft. diam.	2 ft. to 3 ft.
Do. Branches	4	—	—	—
Western Division ..	5¾	14½	4 ft. × 2 ft. 8 in.	4 ft.
Outfall	5¼	—	2 and 3 culverts 9 ft. × 9 ft.	2 ft.
SOUTH SIDE OF THE THAMES.				
High Level	9½	20	4½ ft. × 3 ft. to 10½ ft. × 10½ ft.	53 ft., 26 ft., and 9 ft. at top to 2½ ft. bottom.
Do. Branch	4½		7 ft. diam. to 10 ft. × 10 ft.	30 ft. at top to 2½ ft. at bottom.
Low Level.....	10	20	4 ft. diam. to 7 ft. × 7 ft.	4 ft. at top to 2 ft. at bottom.
Do. Branch	2	—	5 ft. to 5½ ft. diam.	4½ ft.
Outfall	7¾	—	11½ ft. diam.	2 ft.
Total length of all Intercepting Sewers, 82 miles.				

Some Particulars of Original Main Sewer Construction in London.

to circulate up and down the river, often for several days before it finally dispersed. Numerous schemes were put forward for remedying this evil, but the one finally adopted was that of Sir Joseph Bazalgette, who made an unqualified success of it.

In its inception, the scheme is simple. With the natural rise of the ground north and south of the river, the sewage in its natural course towards it was intercepted by high and middle level mains with somewhat longer low level sewers which more or less follow the course of the river from west to east and unite with the others at Abbey Mills on the north side and at Deptford on the south.

Along their course are one or two lifts, notably at Chelsea, and numerous reliefs to pass storm water direct into the river though the main pumping is done at Deptford and Abbey Mills, from which points the sewage gravitates again several miles to the respective outfalls at Crossness (South) and Barking (North), these points

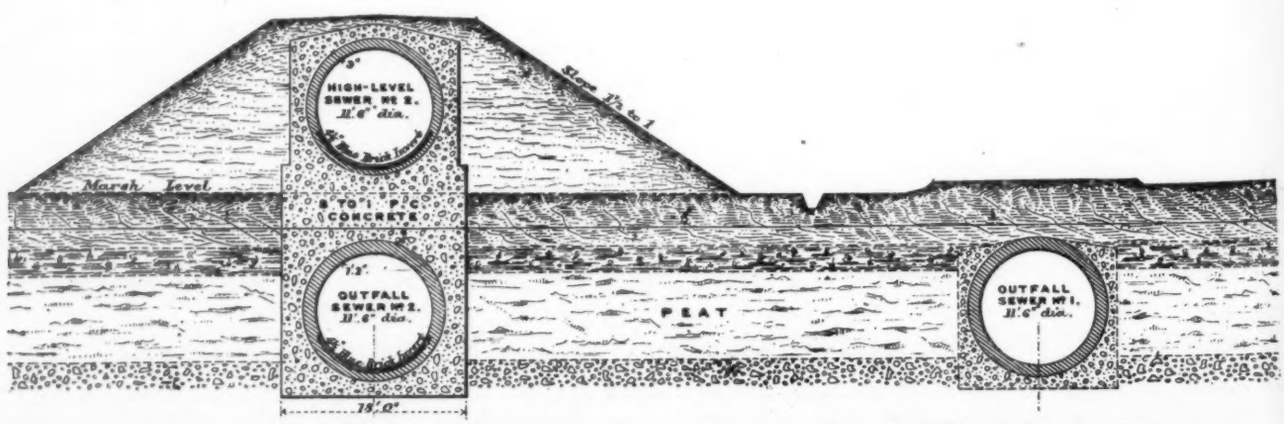


Fig. 3—Southern Outfall. Original Costly Line on Right. Two Present Additional Lines on Left.

having been selected as being sufficiently far down the river to preclude any possibility of sewage returning on the flood tide after being discharged from the storm tanks on the ebb. Except that the sewage is lifted at the southern outfall, the system south of the Thames is much the same as that on the north. When the original scheme was completed there were 82 miles of sewer. The particulars concerning the system, given in the appended table, may be of interest.

While, naturally, this mileage has been appreciably added to a particular point of interest, as will become apparent later on, is that Bazalgette though only having a matter of 2-ft. per mile of fall in the major portion of his trunk mains was not only able to give them considerable reserve capacity but he actually under-estimated their discharging capacity so that the engineers of the L.C.C. have by the construction of reliefs for storm water, and means for pumping out vast volumes of it, actually been able to retain the original lines without much duplication except in the case of the outfalls, of which more anon.

From the table too, it will be seen that the greater lengths of sewer which run up to 10-ft. diameter are of circular section built mainly of brick, and it speaks well for the work put into them and the forethought given to the problem as a whole, that the original works are functioning perfectly well today at approximately twice the original intended capacity.

The West Middlesex Scheme

Of course, what was mentioned as Greater London has long outgrown the original scheme. In the first place it has extended about 10 miles west of what is shown on the plan and that brought into being a number of local purification plants, from which the effluent reached the Thames higher up. These again have now been for the most part closed down and this area in the country of Middlesex is now served by another very large scheme known as the West Middlesex.* Actually the area served by it is 35 per cent greater than that of the County of London, being roughly 160 square miles in extent, though not anything like so closely built on. It provides for a population of 1¼ millions, involves too some 80 miles of main sewer and has enabled 28 purification plants to be shut down. It cost some 4½ millions and was completed only recently. Unlike the L.C.C. system however, which only aims at rough precipitation from which the sludge is taken by steamers and dumped at sea, the West Middlesex plant, which discharges into the Thames much higher up though still into tidal water, has the latest in purification methods including activated sludge, separate sludge digestion, and self-produced gas power to the tune of over 6,000 horse power.

Modernized London Scheme

As pointed out, what the London scheme is doing today is working to a greatly increased capacity without its having been necessary to do much actual duplication. The old steam pumping plants, mostly beam engines, have been largely replaced by electrically and oil engine driven centrifugals, though a unique policy adopted in respect to the works to relieve the mains of storm water has been the use of gas engines.

Gas supply in London, by its two main companies, has been remarkably free from failure and several of these large stations depend upon the gas mains for the emergency reserve power they require. The one at Abbey Mills with seven 500-H.P. sets can handle 700 tons of water per minute to a height of 40-ft. and there is another large one of a similar nature at Hammersmith and several others. Apart from gravitation reliefs into the Thames at Deptford, and into its subsidiary the River Lea at Abbey Mills, some 705 million gallons per 24 hours can be pumped out of these sewers. This is the equivalent of 0.43-in. of rainfall in 24 hours, or what could be regarded as a good steady downpour. Actually 24 hours' continuous rain is comparatively rare in London and there are not more than 25 days in the year on which ¼ inch falls and only about one half of this is expected to reach the sewers.

Little or nothing of this vast scheme is visible to the public at all. Passing up the Thames the professional eye will recognize the outfall works, though they are located in a practically unbuilt on area of flats though the one on the northern side has as neighbors the extensive works of the Gas Light and Coke Co. If, however, one travels over the eastern portion of London, one can hardly fail to recognize what looks like a disused railway embankment running as far as the eye can see in a dead straight line. That in fact is the northern outfall via which the sewage after its 40-ft. lift at Abbey Mills runs wholly by gravity for some 7 miles to Barking. This has always been looked upon as a remarkable work. Its original construction, being here shown in Figure 2, contained an underpass, though it has been enlarged of recent years to five conduits. These conduits pass over roads, railroads and canals mostly by means of cast-iron tubes of the same section as the masonry work. Fig. 3 shows the triplication of the southern outfall. This latter work, seen on the right, runs from Deptford to Crossness, a distance of nearly eight miles, though apart from its being up to 75 ft. deep where it passes through some higher ground in Woolwich, its average depth is not more than 16 ft. Conditions here are somewhat different to those on the northern outfall because while the main lift into it is at Deptford, the sewage is again lifted at Crossness, though in emergency this sewer can discharge direct into the Thames at low water. It looks a good deal simpler a job too, than the northern outfall, though actually the last three miles of it proved exceedingly costly on account of the bad nature of the ground and of the methods, which would seem today crude, which has to be used to build it without such present day facilities as are afforded by shields and compressed air. The fact that but 18 in. of brickwork sufficed for it, is a tribute too, to the original materials—stock brick in Blue Lias Lime mortar—and workmanship in general. The use of Stafford Blue bricks to resist erosion here will be noted also.

The whole system is today serving the D.W.F. of a population of some 6 millions and is able to convey ½-in. of rainfall to the outfall. The storm water reliefs, though they have a total capacity of round 15,000 cubic feet per minute, are only called upon to operate an average of 100 hours per year and flooding is exceedingly rare.

*The West Middlesex Scheme is to be described by Mr. Watson in a forthcoming issue.—Ed.

HANDBOOK OF CHEMISTRY AND PHYSICS

The new edition of Chemical Rubber Co.'s "Handbook of Chemistry and Physics" marks the 22nd revision of this valuable reference work. A folder from the publishers indicates the additions and revised parts of the 22nd edition. It is being offered at $6.00 per copy, in black flexible binding (the owners' name stamped in gold letters being gratis); or, a credit allowance is being made to present users who wish to "trade in" their older editions on the new one. For further details, write The Chemical Rubber Co., 1900 W. 112th St., Cleveland, Ohio.

CLEANING AND CEMENT-LINING EXISTING WATER MAINS IN PLACE

By BRUCE HARKNESS
Engineer, New York, N. Y.*

Bruce Harkness

ON JANUARY 21st, 22nd and 25th, by the courtesy of Mr. Joseph Goodman, Commissioner of Water Supply, Gas and Electricity, New York City, a series of pipelining demonstrations were conducted by the writer, with the object of introducing this method of rejuvenating existing water mains in-situ. These demonstrations were carried out at the Department's Works and Stores at Brooklyn, N. Y., and were witnessed by more than 100 engineers, and water works authorities from many parts of the United States.

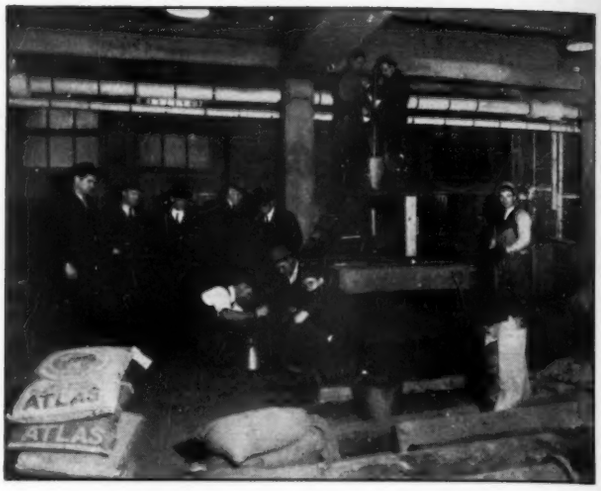
The demonstrations consisted of the cement-lining of some 90 odd feet of Cast Iron pipe, which had been in use for about 20 years, and exhumed for the purposes of laying new pipe; bends were also lined. Prior to the demonstrations of cement lining, the pipes were cleaned, and then laid in a continuous length.

The Demonstration

A predetermined quantity of mortar, consisting of two parts of washed and sieved sand (carefully selected), to one part of Portland cement, was then mixed until a satisfactory colloidal condition had been obtained. When this mortar had reached an approximate slump of 9 inches, it was then plunged into the pipeline through a hopper and a rising pipe connected to a specially constructed junction, which in turn was clipped to the main.

After the material had been plunged into the pipeline, the Tate Spreader or Lining Float was introduced into the pipe and hauled through. This apparatus is in the form of a tapering skirt or tube, having a cone or "bull-nose," tapering to a trailing skirt, in which there are a number of fine perforations for the purpose of de-watering the mortar. The maximum cross-section of this skirt is the same as the bore of the pipe when lined.

During the passage of the lining machine through the pipeline, the spreader is preceded by a series of spring steel guides, which are rearward-set to fit the bore of the pipe neatly; the function of these guides is to ensure true axial alignment in the pipeline. When this tapered spreader is hauled through the main, the mortar is forced on to the pipe wall with increasing pressure, and the excess water escapes through the small dehydrating perforations provided for this purpose in the skirt of the spreader. Sufficient water is removed in this manner to reduce the mortar to such a consistency, that it becomes self supporting and adheres very firmly to the wall of the pipe. The mortar, in effect, is "troweled" on to the pipe wall at a pressure of approximately 130 lbs. per sq. in. In practice the machine travels at the approximate rate of 25 ft. per minute, and lengths from 300 ft. to 1200 ft. can be treated in one "pull," depending on the size of pipe being treated.



Making the Mortar Slump Test Preparatory to the Lining Operation. New York Demonstration—January 22, 1938.

Lining Bends and Specials

Bends and special fittings are either lined in the field or in the factory, in a similar manner, except that the spreader is almost ball shaped, so as to maintain an even thickness of mortar irrespective of the radius of the bend or special fitting. In the case of bends, lined in the factory, a seal is affixed to the ball-shaped spreader which closes the end of the open skirt, so that the cementitious

*American Representative Messrs. Tate Processes, London, England and Sydney, N. S. W.

The Pipe Line Set Up for the New York Tate Process Lining Demonstration. Note Loading Funnel at End of Main, Which Was Lined in 3 Minutes with ¼ in Cement Lining (Photograph courtesy N. Y. City Dept. Water, Gas & Electricity).

Exhibit of Tate Processes Lining Equipment and Lined Specimens. New York City Demonstration. Note on the Floor the Two Types of Spreaders (Lining Floats) Employed as Described in the Article. Note the "Flats" at the Bottoms of the Small Pipe Sections Referred to in the Report.

infiltrations passing through the dehydrating perforations are contained within the skirt or spreader itself.

In field practice, when lining long lengths of pipeline, it is not practicable to catch these infiltrations, or trap them in the spreader, as in the case of lining bends or specials. The dehydrated "slurry" which passes through the small holes in the skirt, trail through the rear end of the spreader, and lie in the bottom of the lining as it is being formed, to produce a "flat." This "flat" section can, if desired, be spread evenly around the finished lining, by means of attaching a "bell" to the rear end of the lining float. Whether this is done or not, the area of the water-way still remains the same.

Values of Williams-Hazen C. on the actual diameters of the pipe after lining have been found to average between 140 and 150. The coefficients measured on the nominal diameters would, of course, vary according to the thickness of the lining applied, and this may vary from ⅛ in. to ¼ in., or more as desired.

During lining operations in the field, temporary service is maintained and the rate of progress, including all operations of cleaning and lining, is approximately ¾ of a mile to 1 mile per week, for each gang of men. All in all, costs of the work vary from 20% to 33% of the total cost of complete renewal of the pipeline.

The Tate Process has been adopted by many authorities as standard practice in many cities in England, Australia, New Zealand, South Africa, and India; and progress is now being made with initial work in the Argentine Republic.

In the last five years, in Sydney Australia, there have been completed some 600 miles or more of pipelines, and it is the board's intention to treat another 2000 miles, proceeding at the rate of 150 miles per annum. All in all, costs in this city are approximately 20% to 25% of the cost of complete renewal. A world total of 1600 miles approximately has been completed to date.

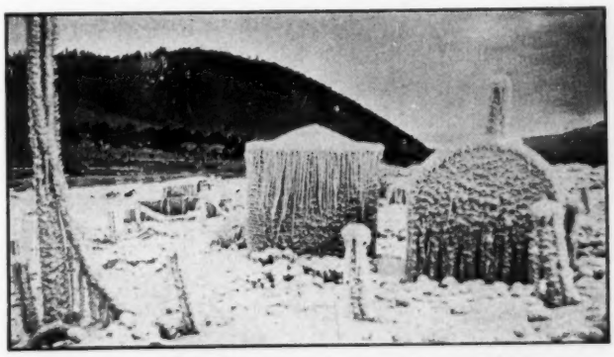
Complete details of the cleaning and lining operations "in situ" will be found in an article by Mr. Thomas H. Wiggin, Consulting Engineer, in the Journal of the American Water Works Association for August, 1935; also, in an article by A. Carrington Wildsmith, Assistant Engineer, Manchester Corporation Water Works, Manchester, England, in the Journal of The New England Water Works Association—September, 1935.

HARRY HENDON MADE CHIEF ENGINEER OF JEFFERSON COUNTY

Harry H. Hendon, for several years past, Sanitary Engineer of Jefferson County, Alabama, has recently been appointed Chief Engineer of the County of which Birmingham and contiguous towns constitute a major part. Mr. Hendon will have charge of the Sanitation Department, Highway Department, Prison Department and County Shops, with an organization of 200 regular employes. Under him are the following Department Heads: M. E. Boriss, Sanitary Engineer; D. A. Helmich, Highway Engineer; Wm. Custud, Chief Clerk; E. H. Gilmore, Supt. of Maintenance of Roads.

Until recently Mr. Hendon had been on leave, serving as Resident Engineer on the new Industrial Water Supply Project of Birmingham. Prior thereto he had performed a creditable job as County Sanitary Engineer in the matter of providing four modern sewage treatment plants for Birmingham and adjacent communities. The main plant, constructed in the depths of the last depression, is probably America's lowest cost plant in whatever manner figured—per capita or capacity basis. Another, the Shades Valley Plant (practically a gift to Birmingham by WPA), soon became internationally known as America's most modern and unique sewage treatment works and, by many, was considered "America's Plant Beautiful," both in design and setting. It was second only to Dearborn in the revived chemical treatment on a modern and scientific basis. It was therefore watched by many. And Shades Valley performance headed many a scheme into chemical treatment.

Mr. Hendon's proficiency was recognized by the New York Sewage Works Ass'n, which voted him its Kenneth Allen Memorial Award for the paper presented before it on the Shades Valley Plant. He was later invited to give a similar paper before the British Institute of Chemical Engineers in London, which he did. Also the young "prophet" is not without honor in his own land; for, he has been elected President of the Alabama Section of The American Society of Civil Engineers. Succeeding Mr. Hendon, as County Sanitary Engineer, is his dependable former assistant, and good friend, M. E. Boriss.



Result of "Hard" Water in Southern California

This picturesque formation is due to a geyser of steam and hot water shooting 90 ft. into the air on one of the water sheds of Los Angeles. Looks like stalactites from the salts in the water, but—Believe It or Not!—these stalactites are the water itself—yes, icicles. At a high elevation in the Sierras, hot by day and frigid at night, these geysers produce such "hard water" effects as here pictured. Los Angelicans for the most part have little intimation that some of their drinking water has been boiled for them and then, just to even matters up, has been frozen before they get it. The cost? Just a little better than 1c a barrel for this super-service.

N.E.W.W.A. DISCUSSES

Financing Water Main Extensions; Taste and Odor Control

AT its most recent Winter Meeting, held by N.E.W.W.A. in Boston on February 17th, the outstanding topic of interest to water works managers and superintendents was the discussion of "Methods of Financing Water Main Extensions." As to be expected, so various were the reported methods employed (mostly of dubious financial soundness) as to warrant a motion that N.E.W.W.A. establish a Committee on Financing Main Extensions, for the purpose of studying, reporting and recommending methods of financing extensions of water mains, with the idea of securing some semblance of uniformity of practice and soundness of economics.

The topic which engaged the chemists in their "Round Table" meeting next door was that of "Taste and Odor Troubles; their Prevention and Correction."

The Water Works School

"The Centrifugal Pump" was the topic of the day in the Water Works School, which has come to be one of the drawing cards of N.E.W.W.A.'s monthly Winter Meetings, and now occupies the first hour of each. The series of 1937-1938 lectures, which have been given by M.I.T.'s Professor of Hydraulics—George E. Russell, have constituted a worthy drawing card, bringing to the meetings an early and growing attendance. The Association decidedly owes a debt to Professor Russell for his clear-cut and simplified expositions of hydraulic phenomena and practices, and equipment items of a common usage in the water works and sewerage fields. His lecture on "The Centrifugal Pump—Elemental Theory, Characteristics and Operation" proved no less understandable and interesting than previous lectures covering "Measurement of Flow," "Water Hammer," etc. With rare ability, at the blackboard with crayon, Professor Russell put the centrifugal pump through its evolution in design and developed graphically what "makes the wheels go round" when it comes to performance of such pumps; why certain types are better than others for certain duty; impeller design and relationship to efficiency, etc. With it he gave definitions of the various principal parts of impellers and casings, and the important features of each.

Interesting part about this Water Works School is that when the hour is up Professor Russell's "class" is still eager for more of his lucid presentation—and that includes the least to the best informed amongst his audience. This School, a great idea, "clicks" month after month.

The President, Warren J. Scott, Chief Engr., Conn. Dept. of Health.

The Vice President, Geo. A. Sampson, Boston Consulting Engr.

E. C. Hultman, Chairman Metropolitan Distr. Commission. (Told about Marathons and "Other Things" on Boston's Water Sheds.)

Warren A. Gentner, Office Engr., Hartford Water Bureau. (Presented Hartford's 85 Years' Experience in Financing Main Extensions.)

Technical Session

(President, Warren J. Scott, in the chair)

"Needed Improvements in the Distribution System of the Metropolitan Water District"—by EUGENE C. HULTMAN, Chairman, Metropolitan District Water Supply Commission, Boston, Mass.

Following the customary luncheon, the first paper presented was that by Mr. Hultman. He first touched on the history and construction features of the important water supply development for Boston and neighboring communities by the Metropolitan Water Supply Commission. Peculiarly fitted for the position as Chairman of the Commission (having had 24 years' experience in utility operation) the speaker has also previously served as Boston's Fire Commissioner and later as Police Commissioner. After discussing the increasing pollution menace on the water sheds of the Metropolitan system, and pointing out by lantern slides the "sore spots" which have been responsible for introduction of chlorination and chloramination of the supply in 1937 to check the rising index of pollution, Mr. Hultman turned his attention to now proposed betterments which would bring greater purity to the water, enhance dependability of supply, greater economy of operation.

By slides he pictured the suggested plans of pressure aqueducts, feeding a large pressure main loop around the city, to be constructed in tunnel. Now ready to draft specifications, such aqueduct would eliminate much of the near-in pollution hazard. Of perhaps greatest importance, this betterment would eliminate pumping of all but 5 per cent of the supply. The study had revealed that by using the recently developed large diameter concrete pipe, similar to those employed in the Southern California Aqueducts, that $12,000,000 could be saved over the cost of constructing a deep tunnel in rock, at first contemplated.

Concerning the procedure in financing metropolitan district's works, namely, by pro-rating costs to communities served on the basis of 33.3 per cent on property valuation and 66.6 per cent on water takings, this scheme, adopted in the beginning, seemed still the most practical and overall equitable basis after the number of years it had been in use.

ARTHUR D. WESTON, Chief Engineer, Mass. Dept of Health, felt called upon to explain the reason for "chlor-

Prof. Geo. E. Russell, Hydraulics, Mass. Inst. Technology. (With Chalk, Made a Centrifugal Pump Do Everything But Pump Water.)

Horace J. Cook, Gen'l Supt. Auburn, Maine, Water District. (Conducted the Supts.' Round Table—Resulting in an Extension Financing Committee.)

amination" and the sudden demand for purer water for the Metropolitan District. He said that good roads and automobiles had taken people into the rural areas to an extent that the once dependable storage factor of large New England reservoirs no longer gave sufficient protection, and that "fresh" pollution was a hazard to be dealt with in these modern days, necessitating chlorination so long avoidable on the Boston Metropolitan Supply.

CHAS. W. SHERMAN, Metcalf and Eddy Engrs., Boston, expressed doubt that pro-rating costs on the basis of two-thirds on consumption and one-third on property valuation is the fairest basis. The scheme had actually resulted in potential takers going to individual sources of supply to save money. Truth was, that water taken by some communities has netted a cost of $135 to $140 per million gallons and to others only $80 to $85 per million. Boston proper paid about the average. To this Mr. Hultman replied that some revision downward seemed in order in respect to the entrance cost to new communities. It seemed logical to allow a credit based on depreciation of existing works.

"Financing Water Main Extensions—Hartford Experiences"—by WARREN A. GENTNER, Office Engr., Water Bureau, Hartford, Conn.

Mr. Gentner's paper set forth experiences during 85 years, with the four methods employed in financing water main extensions by the Water Bureau of Hartford since the beginning of operations in 1853. The early method (1853-1861) of constructing main extensions from water revenues, was dismissed as an "experience."

The second (1861-1922) called for extensions when owners of properties to be served guaranteed an annual income of not less than 10 per cent on the invested capital incident to making the extension sought. The guarantors received as credit on their share of guarantee the payments made for water used. In the long run, experience proved this method unfair to both guarantor and water utility. Each guarantor had to be held liable for the full 10 per cent on the project, should others default. In the opposite direction, there was inadequate insurance of continuity of payments to the water utility in event of change of property ownership or death of the original guarantors. However, for 61 years this method continued in use.

The third method (adopted in 1922) employed the assessment plan of charging all costs for extensions against abutting properties, the legality of such method having been thoroughly established. (1) The assessment charge was taken as the average cost of laying 6 inch mains during the year previous and dividing that figure by the total property frontage (both sides of street) in order to reach the charge per front-foot against properties abutting. (2) The assessments could be extended in 10 equal payments, plus 6 per cent interest charged yearly on unpaid balances; all such assessments becoming liens against abutting properties, whether taking water or not. (3) Corner lots, with a main already in the street along either side of the property, received a waiver on 75 ft. of the side served by the new main.

Amendments to the plan, based on experiences, were early made. The assessment basis was the very next year changed to the per foot cost of 6 in. main installation averaged for the previous *five* years rather than one year. In 1925, to avoid loss to the water utility on those corner lots having a main on one side already, the footage exemptions were deducted from the gross footage in the block. The total cost was then divided by the remaining footage so as to receive full payment for the extension. Later the 75 foot exemptions on corner lots was increased 125 feet. In 1930 the basis of assessment was changed to the cost of installing 8 inch mains. By then, with few exceptions, 6 inch mains were being ruled out of the system in preference for the 8 inch size. Then, because of the need for quicker turnover of money for main extensions, the 10 pay (10 year) plan was reduced to the 3 year plan, with ¼ down and ¼ each year for three years. Interest at 6 per cent per year is charged on the unpaid balances.

Mr. Gentner outlined the routine in proceeding with extensions on the latest plan. (1) The petition is filed. (2) Hearings are advertised, and held, to determine the public necessity and reasonableness of the extension. (3) Having established these facts, the main is installed and all costs determined from records, to which is added overhead expenses aggregating 23.5 per cent on labor and materials. (4) The assessment charges are then established and sent to the Registrar for preparation of bills and filing of liens against the properties. Mr. Gentner then described in detail the process of arriving at per front foot assessments, involving hypothetical 125 ft. deductions allowed corner lots if already served on one frontage by a water main. For 6 inch mains the base rate of assessment had ranged from $1.50 to $1.75 per foot; for 8 inch main from $1.71 to $1.94 per foot.

As to experience with the assessment method (a 17 year period) figures were presented which indicated that only 76.2 per cent of the actual total cost of work done ($1,686,621) was billed in the end to abutting property owners, the 23.8 per cent balance coming from water utility funds. The difference was represented by various circumstances. Of the amount billed out (assessed) 89.7 per cent had been collected during the 17 years, 2.9 per cent had already been abated or cancelled, 1 per cent was overdue 10 years or longer and now in the suspense

P. A. Shaw, Supt. Water, Manchester, N. H. (Vice Pres. of the Association); K. R. Kennison, Asst. Chief Engr., Metro. Distr. Comm., Boston (Chairman of the Program Committee); F. E. Windsor, Chief Engr., Metro. Distr. Comm. Boston.

account. Interest received on unpaid balances had yielded 4.3 per cent on the total capital investment and would cancel out the 2.9 per cent (possibly another 1 per cent) losses due to abatement and cancellations. In explanation, Mr. Gentner said that troubles aplenty came with the depression of 1929, which caught the water utility with thousands of dollars tied up in water mains laid in undeveloped real estate tracts. Consequent defaults, by owner of such property, in assessment payments accounted for a large fraction of the 3.9 per cent of uncollected assessments. In a few flagrant cases properties were foreclosed and taken over by the Water Department.

The fourth Hartford plan of financing extensions, explained Mr. Gentner, had been the outgrowth of an effort to avoid a repetition of losses due to depression conditions. A modification of the assessment plan, it is called "the supply main method." Under this plan a connection charge (fee) is made, when a property connects to the mains, in substitute for an assessment laid against the property when the mains are installed. The fee is actually the full amount of the assessment charge, and is figured as in the past. Under the modified ("supply main") plan, mains have actually been installed where conditions would fail of approval if considered strictly under older assessment plans. Water has thereby been

E. L. Bean, Chief Chemist New Eng. Water & Power Associates. (Conducted the Chemists' Round Table.)

Reeves J. Newsom, Cons. Engr., New York City. (The President-Elect of A. W. W. A.).

cluding loss due to defaulted assessments; more importantly, perhaps, in providing water service to deserving residents with the delay incident to the assessment scheme.

Superintendent's Round Table

(Horace J. Cook, Auburn, Me.—Presiding)

It seemed a little unfortunate that Mr. Gentner's paper on main extension financing could not have preceded the

(1) *Don A. Calderwood, Asst. Supt., Pennichuck Water Co., Nashua, N. H.;* (2) *Ross. Scott, Engr., S. R. Dresser Mfg. Co., New York City;* (3) *Jas. P. Sweeney, "Asst. to the Vice Pres." (Otherwise Asst. Supt.), Manchester, N. H.;* (4) *"Rep" Replogle, Gen'l Mgr., Warren Pipe & Fdy. Co., Boston; Ware, Mass.;* (5) *Geo. F. Merrill, Supt. of Water, Laconia, N. H. (a Faithful Meeting Attender);* (6) *Thos. L. Cate, Supt. of Water, Laconia, N. H. (Collecting Main Extension Guarantees Is Not His Easiest Job);* (7) *Fred E. Smith, Supt. Filtration, Cambridge, Mass.;* (8) *A. A. Kenny, Chicago Bridge & Iron's Smiling New England Sales Engineer.*

brought to properties having immediate use for it, without burdening other property owners with assessments for the mere existence of a main in front of vacant lots. The chief interest of the plan is that it precludes assessment losses, through financial failure of the assessed or property foreclosure because of non-payment of taxes. The unsatisfying feature is that of capital tied up with reduced return until all potential connections are actually made. A study of the two methods (3 year —4 payment) assessment plan on installments as against the "supply main plan," reported Mr. Gentner, indicated over a period of 4 years that the cash income and money turnover (assuming all assessments actually paid) would be greater with the assessment plan.

Taking all things into consideration, during 17 years of the assessment plan with its ability to provide quicker return of invested capital, this plan appears to have a definite advantage over the "supply main" method, even in the face of what happened to it during the depression. In conclusion, Mr. Gentner said that although Hartford experiences had shown that there was no satisfactory substitute for the assessment plan, the "supply main" plan had advantages justifying its use in conjunction with the assessment plan, as a worthy supplement. Apparently the full assessment plan had been entirely satisfactory to those wishing water main extensions. The "supply main" plan had served most effectively in pre-

Round Table Discussion of **"Methods of Financing Water Main Extensions."** From the discussion could be gathered one predominating fact, to wit: that few methods are in use, at even fewer places, which may be graced by the term "plan." Thus, became evident the real need for a comprehensive study of existing methods, looking to the evolution of one or more basically sound schemes which may be endorsed by water works associations. A happy result of the discussion will be the establishment of a Committee on Main Extension Financing, as proposed at the end of the discussions.

The "Round Table" brought out the fact that some prevailing practices of requiring 4 to 6 per cent on the investment in extensions, as the guarantee from owners of properties served by main extensions until the sales of water carried the burden, were inadequate if not ridiculous.

SUPT. WM. NAYLOR, reported that Maynard, Mass., formerly required the 6 per cent interest guarantee but lately requires those served by the extension to pay 50 per cent of the total cost of it.

SUPT. THOS. L. CATE. reported that the Laconia, N. H., scheme involved securing guarantees of 10 per cent of cost yearly. The difficulty was that of keeping in contact with the original property owners—the only guarantors to be held. New owners could not be forced to carry on the guaranteed payments and therefore col-

From Marlboro, Mass.

"Super" Hal Brigham (Left) Brought Along Commissioners "Dan" O'Connor and Chas. Cook of Marlboro's Water & Sewage Commission.

lecting was some harder than getting the guarantors signed.

JOHN ROBINSON, Asst. Supt., Concord, Mass., reported that the former guarantee requirement in Concord had been 4 per cent, but now real estate developers were required to pay the whole cost of the main extension.

SUPT. A. A. Ross revealed that the plan in Lexington, Mass., involved a blanket charge of 90 cents per foot for 6 in. main extension. If a larger main was installed (on preference of the water department) no greater charge was made. The 90 cent per foot assessment applied to all properties abutting on the main, the charge becoming a lien on the property.

SUPT. ROGER OAKMAN reported that in Needham, Mass., the required extension guarantee is only 6 per cent annually on the cost. There had been no trouble collecting. He called attention to the practically universal success of financing sewers 100 per cent through the assessment method. Such was adequately covered by state law. Then, too, there was the legalized sewer rental method of collecting charges to defray operation and maintenance, if not also some of the installation cost. It was his opinion that a legislative act is badly needed to provide some uniformity and soundness in main extension financing procedure.

SUPT. ARTHUR KING stated that in Taunton, Mass., a 10 year guarantee was required of petitioning groups. A rate of $20.00 per year per 100 ft. of 6 in. main was the basic requirement—the water rent being credited in full toward the payments guaranteed. When additional consumers connect to the extension, payment is only made for water taken at regular rates, such income being credited to the joint account of the guarantors.

CHAS. W. SHERMAN, Metcalf and Eddy Engrs., recounted something of the plan of Belmont (Boston Suburb), which involves an agreement signed by the petitioners and backed by a required actual *cash* deposit of 75 per cent of the full cost of the extension. It was his impression that the deposit requirement had been raised to full cost of the extension, based on an installation no smaller than 8 inch size. If any larger main was considered advisable the water department stood the increased cost. For smaller comunities, on any major extension, the cash deposit plan seemed the only adequate solution to the problem. Minor extensions might be financed in other ways, such as the assessment plan.

Water Company Experiences

It was interesting to hear from three privately owned water utilities on their main extension problems.

THEODORE L. BRISTOL, President, Ansonia (Conn.) Water Company, reported that in the practice of making minor extensions to serve a few outlying properties, the company's policy had been to draw up contracts with individual owners at $100.00 per lot as the annual total income, the obligation going with the land as a first lien. As to extension fire hydrant charges, the city paid the company on the inch foot basis for the mains, plus a small hydrant rental. The price paid of 92 cents per in.-ft. was satisfactory, and such payments were deducted from the guarantees of the property owners, on a pro rata basis. Charges for water used were also deducted from the guaranteed payments.

DON A. CALDERWOOD, Engr., Pennichuck Water Company, Nashua, N. H., reported on a 6 month old ruling of the N. H. Public Service Commission requiring private water companies to extend mains up to 100 ft. without cost to consumer. On additional footage an annual charge againt the consumer, of 6 per cent of the installation cost, is allowed for 5 years. The revenue received for water used is allowed in addition to the 5 year total, representing 30 per cent of the cost of the extension beyond the first 100 feet. While the new scheme might not return profit to the utility in all instances it was at least a firm basis for dealing with applicants for main extensions.

(1) John Warde, Rensselaer Valve Co. (Up Selling the "A. W. W. A. Special" to New Orleans), and Jim Turner, Water Supt., East Providence, R. I. (Who Bought); (2) From the Boston Metropolitan Distr. Comm. Came Edw. J. Kelly, Commissioner, and R. M. Holt, Secy.; (3) Wm. F. Damon, Leominster's Chemist of Water and Sewage Works, With E. A. Sigworth of Industrial Chemical Sales; (4) Fred O. Almquist, "Asst. to the President" (Otherwise Engr. of the Conn. Dept. of Health), Hartford, and Builders Iron Fdy.'s M. C. Allan of Providence.

CARTER H. LAMB, Valuation Engr., Jamaica (N. Y.) Water Company, said that in former years extensions were made only upon applications backed by a deposit to safeguard the company against loss, should the real estate development fail. At present the problem of major extensions were not of consequence. Only recently had hearings been held by the New York Public Service Commission on proposed rulings on extension charges. The proposal made, called for the first 150 ft. of extension free of charge to the consumer. For extension in addition a deposit was proposed, such to remain with the utility until increasing earnings from water sales due to the extension justified return of a portion (and finally all) of the deposit. Indicative of the complexity of this problem of extension costs and proper charges to be made, no final decisions have been reached by the Commission. Another question aired in the hearings, which created the greater heat of argument from water utilities, was the question of ownership of consumers' service lines and why these should not be taken over for maintenance by the water utility. On this point there would probably be a war for some time before any agreement could be reached.

SUPT. HORACE J. COOK (the Chairman) revealed an

interesting decision of the Maine Public Service Commission in respect to the water department of Auburn. The Commission now ruled that the water utility must stand the cost of the consumers' service across sidewalks. That is, it being the utilities duty to deliver water to the owner's property line, the service should be the utility's property thereto. To a question, Mr. Cook answered that the curb-boxes would remain at the curb, whereas meters had always been located inside of the house. The utility would run the service to a stop cock at the property line.

With the resolution that a Committee on Main Extensions be appointed to bring some order out of chaos, the discussion on this topic closed.

On Handling Inventories

So much interest was manifest in the main extension topic that little time remained for the second Round Table topic scheduled—"**How Do You Handle Inventories?**"

WARREN A. GENTNER, Office Engr., Water Bureau, Hartford, Conn., said that their more or less perpetual inventories stock ran to about $100,000 value. In reaching inventory values the average costs of stock items during the year were used in the complete annual inventory taking. In former years buying was done on a year-to-year replacement basis, but now on the faster moving items even weekly counts were made in connection with booked inventory, and replacements were ordered accordingly. As to the always perplexing problem—"Small Tools"—attempts were made to charge these off to jobs, otherwise they were charged into the "Clearance Account."

CARTER H. LAMB, Jamaica (N. Y.) Water Co., having an inventory of $112,000 at the year end (kept as low as permissible) stressed the importance of efficient store-keeping and stock-yard operations. Recently his company had put in a traveling crane on a Caterpillar tractor, for handling the yard stock of pipe, fittings and the heavier valves. Mr. Lamb felt that their modernized system of store-keeping, inventory and records might be of sufficient interest to warrant N.E.W. W.A. members coming to look it over. He stressed the costly "leaks" which could be plugged by efficient store-keeping and perpetual inventorization.

▼

HOW TO TRAIN AND SELECT GOOD JOINT MAKERS

By Wm. W. Rapp*

Superintendent,
Construction and Distribution, Atlanta, Ga.

The purpose of the device here pictured is for the training of men in the Atlanta Water Department in the proper method of yarning, pouring and caulking joints on cast-iron pipe. The split-sleeve is used in order that the novice can take it apart to see what has been accomplished in his work. Also to see what a perfect joint job looks like if a pipe bell could be split in two.

The sleeve is an ordinary cast iron split-sleeve. One half of the sleeve is secured with the split surface up, in a horizontal position to stand 3½ in. high, made of ⅜ x 2 in. flat steel. This stand is bolted to a 2 x 12 in. board 3 ft. 6 in. long. The purpose of elevating the sleeve is to allow room under the pipe for the caulking operation.

On each end of the board is bolted a stand made of ½ x 1 in. steel, with the top depressed to fit the lower part of a 6-in. pipe. These stands are of a sufficient height to bring the ends of the pipe in a horizontal position when resting in the proper position in the sleeve.

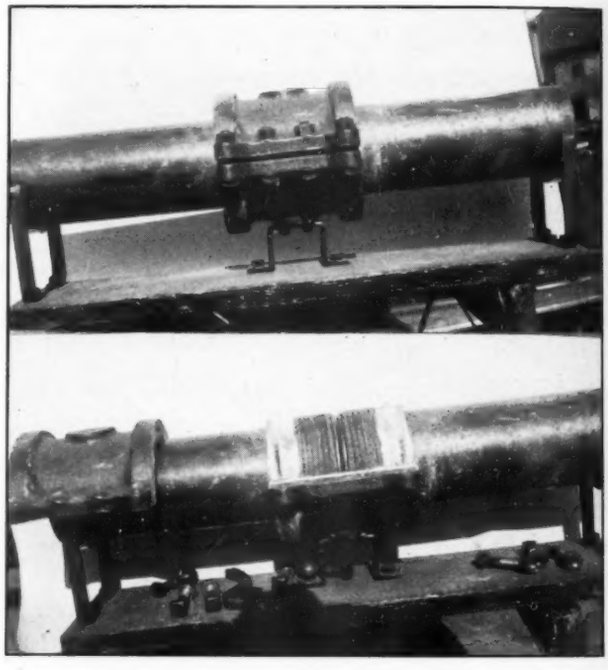
Two pieces of 6-in. pipe, 21 ins. long, are used. On the abutting end of each pipe a ring, made of ⅜-in. round steel, is shrunk. These rings serve as the bead does, on the end of pipes, to prevent yarn from being driven too far.

Practice Use

When a promising man is found amongst the department's construction and distribution division employees he is given the opportunity of learning to yarn, pour and caulk joints. First he watches an experienced man make a joint with this sleeve. When the joint is made the top of the sleeve is taken off and the "student" sees the condition of a properly made joint as it actually appears in the bells of pipes. This may be done several times if need be.

The joint is then cut out and the "student" proceeds to bolt the sleeve together on the pipe and make the joint as he has seen it done.

As soon as he has made a reasonably good joint he is left to his own devices with the practice sleeve. He



The Atlanta Training Joint. Above: Split Sleeve in Place for Caulking. Below: Upper Half Removed for Job Inspection. (The Boy That Made This Joint Must Have Been a "Post-Grad"—Editor.)

makes a joint and calls the foreman, or another qualified to inspect his work. He is shown the defects, if any, in the joint he has made. He cuts out the lead and yarn, bolts on the sleeve, and the procedure is repeated until he is competent to make a joint as it should be made. This may require a day or more but is well worth while as it obviates the necessity of allowing an inexperienced man to begin his experience by making joints on a main in the distribution system. It also allows the Water Department to keep several competent joint makers available, instead of having to rely on only those which are regularly performing this type of work.

*Honorary Member, A.W.W.A.

"PUMPS AND PITFALLS" OR

*Some Random Thoughts on Sewage Disposal by a Mere E. E.**

By VICTOR GREIFF

Electrical Engineer
Department of Sanitation,
New York, N. Y.

The Author

AS YOUR Chairman has told you, I am an electrical engineer (a mere E.E.), but have been connected with the sewage disposal systems of the City of New York for about 15 years, during a part of which I was detailed to take charge of maintenance and repair of plants and outfall sewers.

These old plants, now rapidly being superseded (several being demolished for construction under the new program), served as an illustrated history of the mechanical engineering of sewage disposal plants—or, the lack of such in many instances.

The Economics of Raggy Sewage and "Home-Made" Chlorine

One of the plants, for instance, pumped sewage by duplex compound reciprocating steam pumps. It was discovered shortly before the electrification of this plant that these pumps would pump sewage even with entire valve discs missing. Here is the only instance where rags had any place in sewage; they would collect on the valve spider and check regurgitation—pretty economical valving.

One of the plants had originally been completely equipped for the historic generation of chlorine gas from manganese dioxide, salt and sulfuric acid, in a lead lined system with steam heating. Contrast with this liquid chlorine now used in trouble free one ton drums in all new plants. And the ease of controlling chlorine feed with the turn of a small knob on modern chlorinators.

Much of the work that came up was the repair or elimination and replacement of equipment, and I fear that my outlook upon sewage plant equipment has become anything but optimistic. I would gamble on it, however, that if the rank and file of sewage plant operators could be heard (in an "off the record" symposium) they would not differ so much from me.

The recognition of the so-called "Process Industries" as a prominent division of engineering, carries promise to sewage plant design and a considerable help in equipment problems. It should at least be possible to obtain equipment suitable, both in materials and design, for exposure to the deteriorating influences encountered in sewage disposal practices and to measure and control operations—but, even the apparently simple problems frequently conceal pitfalls.

Innocence and Repentance

For an electrical engineer (a mere E.E.) to be faced with problems of sewage plant maintenance and operation is quite an unusual condition, and starting out in open-minded innocence (later on "repentance") I had many strange experiences and derived certain general ideas which I give you for what they are worth.

The trouble begins promptly when the sewage comes into the plant: Fact No. 1 is: *"Sewage is anything that is in, or comes out of, a sewer."* So, at as much as 40 feet below ground level, or 20 feet below sea level, torrential rains bring enormous charges of silt and sand, discarded dairy cans, horse blankets, baby carriages, a racing sulky, or a few hundred tons of small coal. Melting snow disposed of by sewer dumping carries the garbage and ashes of a slum neighborhood for half a winter.

From out of town, we have heard reported, quantities of gasoline and naphtha—afire in one case—and recently, a carload of grain a day arrived at a plant for weeks.

On the other hand, the theory of sedimentation refers back to the mathematics of fine particles, and when clarifiers won't clarify, we are told, of course, "your ionization potential is wrong; you need a couple of chemical dry-feeders, or liquid feeders, dissolving pots, a flash mixer, a chlorinator and a flocculator"; and, perhaps, a magnetite strainer should be added, just in case.

Art vs. Science—Fact No. 2

A brilliant general engineer (of wide experience) after a couple of years contact with the subject, has remarked that sewage treatment is distinctly an "art" rather than a "science."

Furthermore, while a general similarity exists between most of the wet industrial processes, it will not do to lift items into the sewage disposal "art" too freely.

For years it was impossible (it still seems difficult) to obtain a pump which will pump raw sewage continuously without its dismantling for cleaning. At least this seems true in the open competition, as required by the N. Y. City Charter. Even pulp and slurry pumps from paper industries were found unsuccessful in handling raw sewage, carrying rags, laundry, bathing suits, etc. The practice of coarse bar screening and grinding up the screenings constitutes a "hope" as one method of solving the problem of raw sewage pumping. Inconsiderate solids do not always put their broad face forward when reaching bar racks—and another "hope" becomes mere "wishful thinking" when a solid so breaks the rules laid down by the engineer.

Furthermore, grinders and similar rotary devices which could handle rocks, bones or half-inch bolts, jammed up and stalled their motors when fed "slightly too fast" with

*Bringing in a bit of levity to a discussion before the Sanitation Group during the Annual Meeting of the American Society of Mechanical Engineers Dec. 6, 1937. The captions being ours.—Ed.

the mess that collects on a bar screen. So, automatic raking and grinding equipment must include load limiting regulation on the feed to the grinder.

Rule No. 1

Such facts lead to *Rule* No. 1: *"Design sewage plant equipment for operation."*

This sounds easy, but seems to require a technological clairvoyant, and accounts for many gray hairs and knotted brows.

Designing for "operating efficiency" is, of course, correct enough but the latter, without the former, is like the "grin without a cat" with "Alice in Wonderland." though not as funny and (unfortunately) neither as rare.

Another feature of sewage plant design that only develops with a long-pull campaign, is the varying life of the component parts of these plants. Particularly in a great city near sea-level, where plants and tributary areas are large, where receiving levels are low, and where costs of substructures run into tremendous figures. In the case of the Ward's Island Plant at least two-thirds of the nearly 23 million dollars of cost was in intercepting sewers, tunnels, tanks, etc. And, it is quite obvious that the life of those structures is at least several times the longest imaginable life for most of the items of mechanical equipment.

It follows that some engineer, at some date in the future, will be faced with the problem of fitting new improved equipment into these structures. (We are still doing it to our old plants.) So, let us bethink ourselves of this future engineer. That is, let us make Rule No. 2:

Rule No. 2

"Do not fit massive structures closely to the mechanical equipment—i. e., design broadly and then set equipment in place."

To do this, against the pressure of cost limitation, takes courage. But, if the designers and in the drafting room are allowed to pour the structures around the equipment, we are molding a one hundred year investment to fit a short-time one—i.e., equipment of a much shorter life expectancy. Sewage plant mechanical equipment has been observed to live from one week to fifteen years. (I see resproachful looks from one or two veteran equipment designers in the audience) I will correct myself by saying that there have been a few exceptions in *both* directions.

Professor Carpenter, in his paper just presented, is most clear-seeing when he deplores the tendency of the equipment specialists to perfect a machine regardless of the next step in the process.

Standardization

While standardization of functions and names of units is perhaps one of the aims of this Section of the Society, plant design by picking out a good make of each of the devices, which seem to be required, is as yet by no means possible. The various functions refuse to stay in their labeled places and frequently the results resemble some of the famous (perhaps "Infamous") Imhoff tanks which operated "upside-down," as we have been informed.

The problem of sludge drying, for instance, is much modified when a park department can take the wet sludge by pipe-line, for an estimated ten or fifteen years, and then later by barge to agricultural lands or to sea.

Simplification

On the other hand, processes that would seem most difficult are sometimes the most simple in operation. For example, the handling of liquid chlorine through long pipe lines; the use of high-tension motors with automatic control in sewage pumping; the operation of methane gas-driven engines with alternator sets in parallel, and at varying frequency for pump control.

These, however, are all characterized by an involved scientific basis, which is sound; the use of only tried elements; and comparative independence of the actual properties of the sewage.

Much electrical equipment carefully thought out and specified, is in this class; it has been said that one "falls over some electrical device at every step" in the modern plants, but rarely do such devices give trouble. Strangely enough, gas engines involve even more electrical complication for ignition, control, metering, safety and alarm devices, than does complete electric drive.

Engineer Fitness

Men of the Civil Service grade of "Operating Engineers—Electrical," have been used in the starting and operation of the plants. They seem very well suited to a "Process Industry" of this kind, where their trouble-shooting abilities may be challenged by an automatic voltage regulator, a couple of check valves set in opposite opening direction in a maze of hot water piping, or a half yard bucket of dirt-fill finding its way into a clarifier during night work.

To sum up the situation, handling and "laundering" the whole "spent water supply" of a great city (plus storm water) involves a wide range of engineering processes and is a comparatively new field requiring continuous checking back on *fundamentals*.

It requires a wide and thorough technical training and offers the young engineer a future—exciting, demanding; and, promising anything but tranquility, I can assure you.

▼

HAMMOND GETS A NEW TANK

Hammond, Indiana, has nearing completion a new 1,500,000 gal. tank here pictured. The flow line will be 95 ft. 6 in. above ground. The tank, of radial cone design, is supported on the newer type tower of cylindrical columns (52 in. diameter tubes), which is apparently new practice in the design of tanks of such large capacity. It certainly has a substantial and business-like look about it, and Hammond will know why when this "give and take" reservoir begins to float on the distribution system.

New 1,500,000 *Gal. Tank at Hammond, Ind.*

THE HUMAN ELEMENT OF PUBLIC RELATIONS

By MENTOR HETZER

Superintendent, Moundsville Water Co., Moundsville, W. Va.

The Author

GOOD public relations, as you know, is an essential factor to the success of any business. Especially is this true in the case of a public utility—whether municipally or privately owned—because a public utility sells a commodity vitally necessary to the well-being of the inhabitants of an entire community. Furthermore, the public is compelled to buy electricity, water, gas, etc., from a single source; so, as a result, there is no competition, underselling or price variations, such as are established practices in many other forms of business.

Because of the right of monopoly vested in public utility enterprises—and again I say, whether privately or municipally owned—Mr. and Mrs. Citizen naturally expect one hundred per cent service at all times. Not only have they the right to expect mechanical efficiency, but they have a similar right to receive interested, pleasant and courteous treatment from the people who represent these utility services.

In fact, the "human element" of any business establishment is more important at present than ever before. It seems to me this is true because of several reasons. One is, that the general public has been taught by certain far-sighted concerns to expect courteous, fair treatment from company representatives. But, more than this, industry is on trial today, a trial in which it must justify its very existence. Needless to say, good public relations beget favorable results.

Start on the "Hiring Line"

This morning I would like to say a few words about the "human element" phase of public relations. Let's start prior to the first point of customer contact. This spot we might refer to informally as "the hiring line." When a man or woman applies for a position in which he or she will come in contact with the public—no matter how infrequently—there are two important factors which the prospective employer should consider about the applicant: One, has the applicant a pleasant expression and, two, a pleasing personal appearance? Naturally, the usual qualifications of honesty and moral character must be considered and we assume that the pleasant expression here referred to does not mask a blank mind, nor does the pleasing appearance suggested necessitate a dandified look. It is well to remember that no matter how deliberate the care shown in the selection of clothes or the attention applied to grooming, if the facial expression is that of a "sourpuss" the impression is anything but desirable. Just so, a winning smile can be badly blurred by an accompanying untidy appearance.

So, first of all, try to get employees who do not handicap themselves—and in turn the management—by carelessness of dress or expression.

If the prospective employee has the first two qualifications mentioned and the other important requisites of honesty, etc., then he should be good material for a job involving customers contacts. Remember, however, I said he would be "good material," which does not mean that he is a finished product in gaining the good-will of customers. Matters might be simplified if such were the case, but, unfortunately, there is more to be considered.

After we have our neat and personable employee, we find that these two requisites alone need additional support. Another quality he must have, or acquire, is a friendly attitude—so needful if he is to help sponsor public good-will.

Of course you may say that a person who thinks enough of himself to cultivate a pleasant expression, supplemented by a spruce appearance, probably already will possess a friendly attitude. But—and here is the rub—to have a friendly attitude a person must think of the other fellow, and not merely of himself.

Especially is the friendly attitude a foremost essential to the employee during a business conversation on the telephone, because at such times his voice is the sole representative of his entire person. A fresh shave, newly shined shoes or clean hands and face are non-existent to the person at the far end of the connection.

Furthermore, still having a friendly attitude in mind, in telephone conversations and in person-to-person contacts the employee must treat every customer with equal attention and courtesy—the man in the shack as well as the man in the mansion. Good-will can never be built if the company representative reserves his friendly attitude for only a select few. In the case of the public utility company, or department, good-will embraces the whole of the population served. For, after all, the public is the "Big Boss" of the entire operation.

In summing up the friendly attitude phase of my remarks I believe it is safe to say that any organization which tries to instill a friendly attitude toward customers, in the minds of its employees, will be repaid immeasurably through better public relations. A friendly attitude, it is well to remember, is reflected by the employee in his ready, interested attention to grievances voiced by *any* customer. A cashier, meter reader, salesman, or what have you, who assures the customer that the matter will be looked into carefully, has a fair chance of killing a grievance and making a friend. I mention such conduct specifically because there have been too many instances in which the customer is given to understand, in a most patronizing tone, that the customer is no doubt mistaken, for the company never makes mistakes.

All of us, I think, will admit that a concern with employees having a good personal appearance, pleasant expressions and a friendly attitude, should reap substantial rewards in public good-will, of course granting that the policy of said company meets with community approval. Nevertheless, I feel, there is still one more desirable quality to be considered, and that is, interest in the customer.

Showing an alert, discreet interest in problems of the customer is going a step farther than merely exhibiting a friendly attitude. By interest in the customer I mean showing a genuine desire to be of as much service as you can. Make him feel welcome, for he certainly should be. Even in matters of a strictly business nature, open the conversation with a pleasant inquiry, or remark, about something of interest (his family, home or hobby)

to the customer. To make the customer feel you are really interested in matters important to him is always a sound plank in a good-will platform.

Closely allied with the friendly opening remarks, and in fact of greater importance, is the ability to consistently call a customer by name in greeting. Dale Carnegie in his widely read book, "How to Win Friends and Influence People," stresses this point most emphatically, saying that nothing is of greater importance to a man than his name.

There are other requisites besides the four precepts here referred to through which employees can help create and maintain good public relations. But the four I have listed; that is, pleasant expression, good personal appearance, a friendly attitude, interest in the customer, might well be called the four essentials in seeking public goodwill. None of these attributes are difficult for a good employee to attain. In fact, without them it is impossible for him to be a good employee, be he a representative of a publicly owned or private operation.

Some one with an excellent understanding of human nature wrote the following simple plan for making friends of customers: "In every transaction with every customer, each meeting should end with a pleasant feeling in the customer's mind that his business has been efficiently and courteously handled."

To successfully carry out this plan, every member of an organization doing business with the public must practice the four fundamental ingredients for winning the approval and good-will of the public. If an entire organization is imbued with this spirit it will make friends among its customers. And, without these friends it cannot long continue to operate successfully.

▼

SOLUTION FEED CONTROL

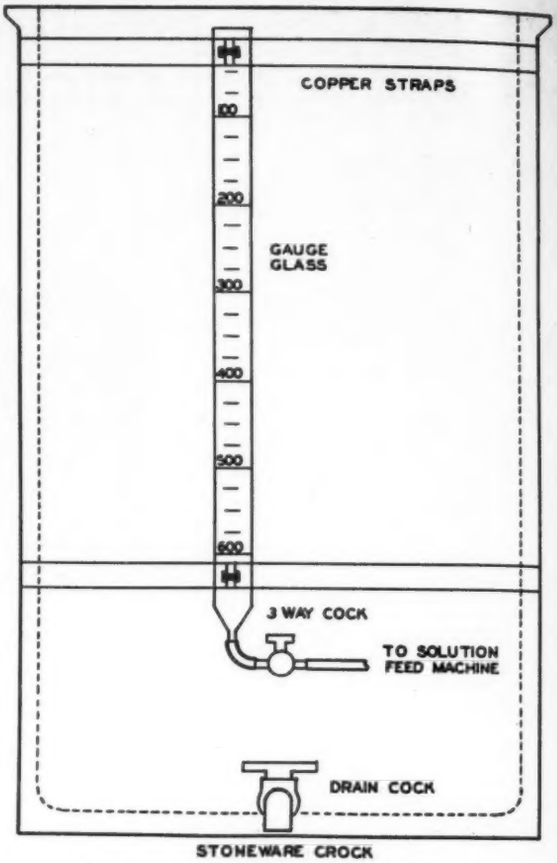
By T. M. RIDDICK

Consulting Chemist, New York City

WITHIN the past few years there has been a rapid increase in the use of solution feed equipment for pressure filters and small water supplies with pumping rates of less than about 700 GPM. This trend now fills the long-felt need for apparatus of a capacity below that of standard dry feed machines or vacuum-type chlorinators. These feeders are of diaphragm or piston type and discharge roughly a maximum of 250 ml. per minute for single units, with duplex rating of approximately twice this figure. Experience with both plunger and diaphragm pumps, operating under a negative head, emphasizes the possibility of flow stoppage due to clogging of suction or discharge lines, loss of prime through air leakage, air binding, etc. If the machine is fed by a suction hose extending over the rim of the solution crock, it is most inconvenient and difficult to judge at what rate the solution is being added, and whether the discharge is constant.

A new type of solution feed arrangement is shown in the accompanying drawing. It has been used with excellent success by the writer.

The crock illustrated is a fifty-five gallon stoneware pot of substantial construction. The drain-cock can be furnished as standard equipment and provides an easy way of drawing off sludge which will in time accumulate from commercial chemicals. Six inches above the center line of the draincock is placed a three-eighth inch three-way hard rubber cock and T. (See sketch.) This location prevents clogging of the feed line by sludge or chemicals which have not completely dissolved. (It is better to have this cock installed at the factory, since the hole may be drilled more readily at the shop than in the field.)



Rate Checking Solution Feed Arrangement

The gauge glass is made by drawing down one end of heavy-walled Pyrex tubing of 38 mm. diameter. The tube, as pictured, is calibrated at 25 ml. and number marked at 100 ml. intervals. However, it may be graduated at intervals of 10 ml. with no overcrowding of division lines. The gauge glass enables the operator to observe the height of solution in the crock without close inspection, and also affords a means for measuring the amount of solution used daily since the tube calibration may be interpreted in terms of gallons of crock capacity, or, pounds of chlorine, alum, ferric-chloride, etc.

In order to ascertain the specific rate of feed, it is only necessary to turn the three-way cock 180 degrees. This causes the solution to be drawn from the gauge glass instead of from the crock, and by noting the time (in seconds) required for a drawdown of say 100 ml., or, by observing the drawdown in ml. for a period of one minute, the rate of discharge of the feed machine can be accurately established.

It also serves as a very ready method for determining whether or not the machine is feeding at all. For instance, clogging of the feed line often occurs when using chemicals shipped in burlap bags, due to small threads which pass into the crock when bags are emptied.

The gauge glass is held in place by two copper or monel straps, which secure it to the solution pot.

It is advisable to attach a high speed mixer to the crock to assist the operator to quickly and easily prepare solutions. When hypochlorites or ferric salts are used the shaft and propeller of the mixer should be coated with rubber or heavy bituminous enamel.

The cost of the equipment is negligible when considering the operating facilities afforded.

EXPERIENCES WITH COPPER TUBING FOR WATER SERVICES*

By J. K. VAN BRUNT

Supt., Water Department,
Manasquan, N. J.

The Author

WATER DEPARTMENTS are constantly confronted with the problem of which is the best kind of pipe to be used for service work. Probably there exists no single material which may be considered perfect for all service conditions encountered. Individual experience is probably the best guide to the selection of the correct material to use. Lead, iron, or even unprotected steel, may prove perfectly satisfactory in some water and soil conditions.

We have, however, found at Manasquan, with our more or less peculiar type of water and soil (a large part of the latter being sandy and wet), that copper has proven itself the best material for service installations, from the standpoint of long life. Consequently, we now are using extra heavy soft annealed copper tubing exclusively for service work. The grade we use is that classified by the manufacturer as Type K.

Our water supply is derived from shallow artesian wells, with little or no treatment other than areation, sedimentation and periodic dosage of the reservoir with copper sulphate for control of algae. The water is characterized by extremely low temporary hardness and a very low pH value, this value being about 5.3. Further, heavy growths of iron bacteria are experienced in the distribution system. These bacteria are principally of the filamentous type, predominantly crenothrix. We are at the present time looking to methods of treatment to correct these troubles.

Lead vs. Copper

This type of water, although only moderately corrosive to copper, causes severe rusting, tuberculation and red water troubles if we use iron or steel pipe. In the case of lead, we find this iron bacterial deposit adhering to the walls of the pipe, eventually restricting the opening to the point where complaints from poor pressure and volume are frequent. We have observed this same phenomenon in the case of copper also, but to a much lesser degree. The reason may be attributed to the fact that copper exerts a poisonous effect on certain microorganisms and thereby retards such formation.

We have found it necessary to remove many lead and iron services because they become a source of annoyance and complaint. Copper lines, installed for periods of 12 to 15 years, have not given us this trouble. We have observed, further, that copper tubing is more effective in withstanding external corrosion in our salt marshy and sandy soil. Iron pipe in this same soil has a tendency to pit and rust, particularly at threaded joints, whereas, the only apparent external effect on copper is a slight roughening by corrosion. In general, I think copper does not have the tendency toward localized corrosion which is so destructive to ferrous pipes.

Methods of Installation

We have found in most cases that our installation problem is not serious. After insertion of the corporation cock the copper tubing is directly attached and the end of the tubing is used as a nozzle to sluice the line through and in place. This procedure is general in sandy soil for distances up to 20 feet.

In clay soil it is sometimes necessary to auger a short distance and then drive a ¾-inch galvanized pipe the required distance, after which the copper is attached to it and follows through as the iron pipe is withdrawn with a pipe pulling jack.

Replacing existing iron service lines with copper is a relatively simple matter. The tubing is attached to the old line by means of a copper to iron pipe coupling. As the iron pipe is removed by pipe jack or block and tackle the copper service pipe is pulled through into its place.

At the main the copper tubing is formed into an expansion bend and, therefore, the usual lead gooseneck is not required for this connection. The corporation cock of the compression type will hold the flared end copper tubing. No thread cutting is necessary and a hack saw suffices for cutting the copper tubing to the requisite length. Compression type joints are used exclusively. We are seldom troubled with a leak in this type of connection if the joint is made with a proper flanging or flaring tool. We feel this flared fitting to be superior to the solder sweat-joint for underground work.

We have had particularly troublesome leaks on the old type flange lead joints where service lines are laid in beach sand. We find that even the smallest leak will eventually develop into something a lot worse. Water dripping or flowing from a leak displaces the sand around the pipe. This churning and abrasive action of the sand very rapidly eats away the lead pipe, the leaks become bigger and repairs are next in order.

Maintenance

Complaints of low pressure due to corroded lines are corrected by the installation of a new ¾-inch copper service. The old ⅝-inch taps are disregarded and new full size ¾-inch taps are provided. We have never attempted to clean a service line. The customer pays the actual cost of the time and labor involved in replacing the service. In the case of new services the water department provides the connections inside the curb line and is of course responsible for their maintenance.

Everything considered, copper seems to be the best material for service lines that we have used. In spite of the fact that, at the present market price, extra heavy copper is higher than most other pipe materials we feel that the very best grade of copper tubing and fittings we can get is the cheapest service line we can install.

*A paper presented before the New Jersey Section of the American Water Works Assn., and here published by permission of the Editor of the A. W. W. A. Journal.

A Floc Detector and Control Cabinet

And a Tap Sterilizer

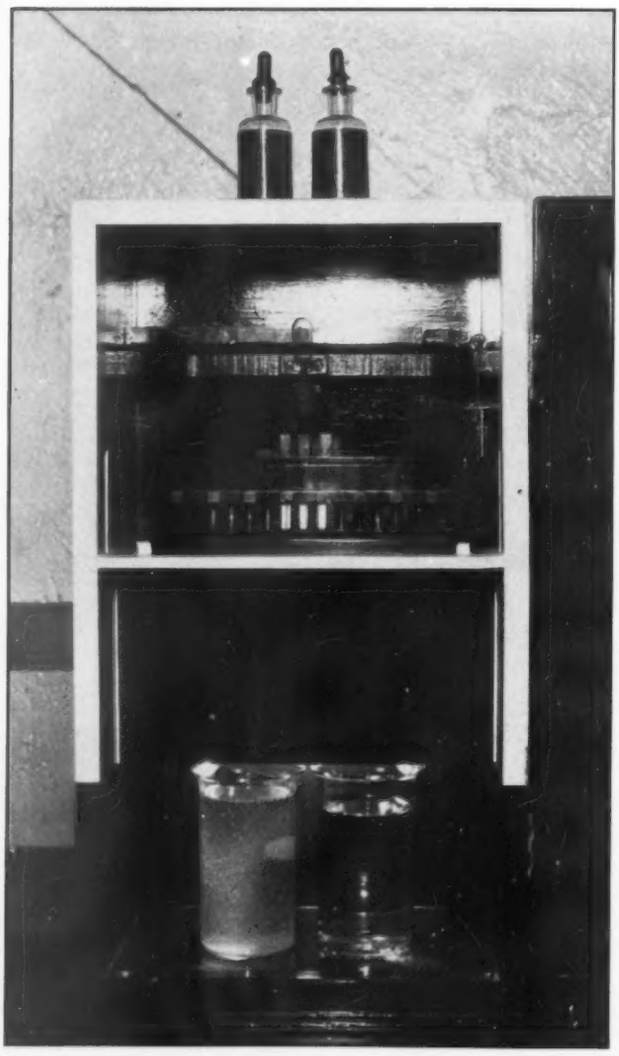
By H. E. Lordley

Plant Manager,
Dept. of Utilities, Richmond, Va.

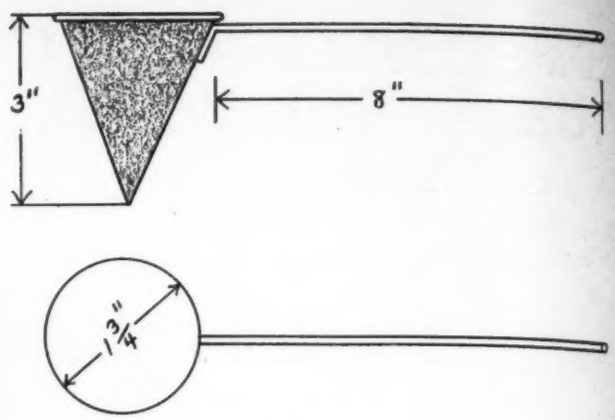
The floc detector here pictured was designed and built by P. W. Blankenship, an employee at the Filter Plant. The cabinet contains a complete operator's laboratory for both day and night work.

Richmond's Lordley and Blankenship

The Richmond Filter Plant has a coagulated water settling period of from 6 to 14 hrs., depending upon the number of coagulation basins in service. It is essential for accurate plant control, and economy, that a sample of water be takn from the end of the mixing chamber every thirty muintes. This sample is allowed to settle to give an index as to the correct dosage of chemicals. The lower section of the floc detector is devoted entirely to this test.



The Richmond Floc Detector and Combination Operator's Control Cabinet



Tap Sterilizer

Using the Detector

A sample of water from the mixing chamber is taken in a 600cc. pyrex dye pot. The sample is placed under the dividing partitions, behind which is a 100-watt frosted lamp bulb. After a settling period of from 15 to 30 minutes the operator can immediately tell the expected condition of the settled water 6 to 14 hrs. hence. Here pictured are two beakers in the cabinet, the first beaker immediately after mixing, the second beaker after 20 minutes settling period. In routine plant control the previous beaker (sample) is always saved for comparison with the new sample.

The Test Cabinet

The upper section of the cabinet contains the chlorine and pH standards. A 15 watt clear daylight bulb, behind a square piece of daylight glass, gives a constant light for both day and night determinations. We have found by experiment that the maximum color of the ortho-tolidine reaction develops in 5 minutes at 20° C., using an Enslow Slide Chlorimeter. The cabinet is equipped with a 5 minute sand glass (seen above) and a standard thermometer for the chlorine determination. In addition, the pH standards slide and extra tube is conveniently located on the upper shelf and can be easily substituted for the chlorine standard slide.

On top of the cabinet two solution bottles are securely mounted. One bottle contains ortho-tolidine, the other bottle contains meta-cresol purple indicator, both having tight fitting rubber bulbs and pipettes. The cabinet is painted dark green on the inside, to give the best lighting effect. A glass paneled door completes the cabinet to eliminate dusty standards and equipment.

The cabinet has been in continuous service for one year and has prevented under-dosing or over-dosing of coagulants and chlorine, and has increased the efficiency of plant control generally.

A Handy Tap Sterilizer

A metal cone and handle were made in our shop from scrap metal as illustrated. The cone is filled with rock wool commonly used for home insulation, and will absorb denatured alcohol readily. The alcohol will burn freely and leave the non-inflammable rock wool "wick" intact. This gives a quick, clean, efficient method of sterilizing taps when collecting samples from the distribution system.

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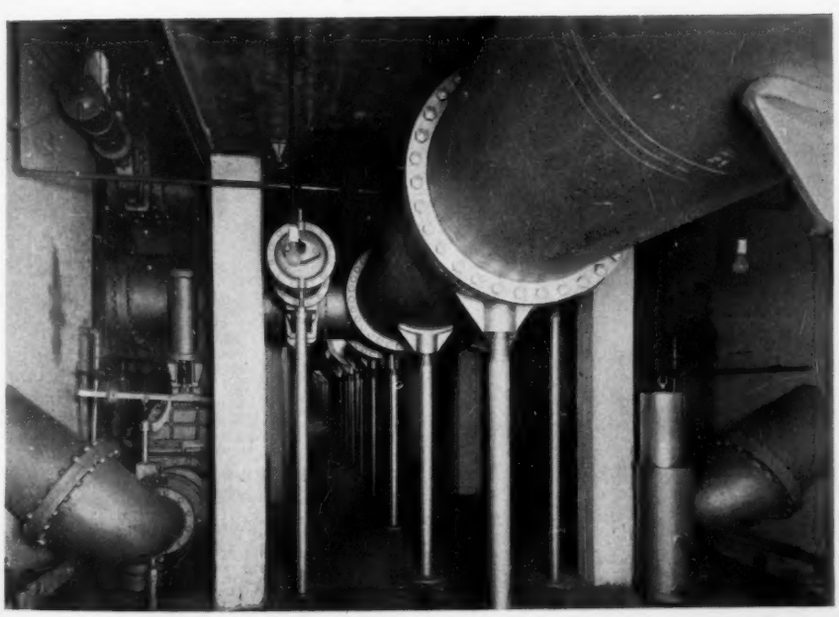

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DEFINITIONS OF TECHNICAL WORDS AND PHRASES

BY

VICTOR J. BROWN, C. E

Publishing Director
Roads and Streets

AND

DELMAR G. RUNNER, A. B., A. M.

Assistant Materials Engineer
U. S. Bureau of Public Roads

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"CHLORINATED-COPPERAS"

By F. O. BALDWIN

Chief Chemist, Dept. of Utilities
Richmond, Va.

AT the Richmond Filter Plant ferric iron coagulation was experimentally tried some three years ago. On a plant scale the most economical source of ferric iron appeared to be chlorinated ferrous-sulphate solution—now known as "chlorinated-copperas" and first used as a coagulant for water by Hedgepeth and Enslow at Elizabeth City, N. C.

The use of chlorinated-copperas at the Richmond plant has proved a boon in enhanced efficiencies and economy, as previously recorded in the literature. The process, which involves dry-feeding of sugar copperas (ferrous sulphate of commerce) and adding chlorine water, from chlorinators, to the resultant copperas solution, continues in successful use at Richmond. In routine and experimental laboratory tests, incident to flocculation control, it has been demonstrated that freshly prepared chlorinated-copperas solution (as in plant practice) produces results more comparable to those reproducable in plant scale operations, and superior to those procured when using a "stale" solution of the oxidized iron solution. It is therefore important to prepare a fresh stock solution of chlorinated copperas daily for the laboratory tests in plant control. Such control means many dollars saved annually in the coagulant bill. On this account a quick, accurate, easy and safe method of preparing the chlorinated-copperas was sought. The following scheme seems to meet all of the above specifications.

The Apparatus

The apparatus which we have been using so successfully for about two years for the purpose of chlorinating copperas solution consists of the following. (See picture.)

(1) A burette stand has a 50 cc. gas burette connected to the tubulature of an aspirator bottle (at the bottom), by means of a 20-inch length of good quality rubber tubing of rather small bore.

(2) A nine pound capacity chlorine cylinder* and connections to the top of the bottle. We use a combination of copper tubing and rubber tubing, with a short length of glass tubing projecting through a one-hole rubber stopper to fit the aspirator bottle.

(* Procurable from Wallace & Tiernan Co., Newark, N. J.)

(3) An aspirator bottle of 500 cc. capacity, holding a medium sized funnel, the function of the funnel being to get the copperas into the bottle.

(4) Two 200 cc. volumetric flasks. (Phosphoric acid flasks are well suited for this purpose.)

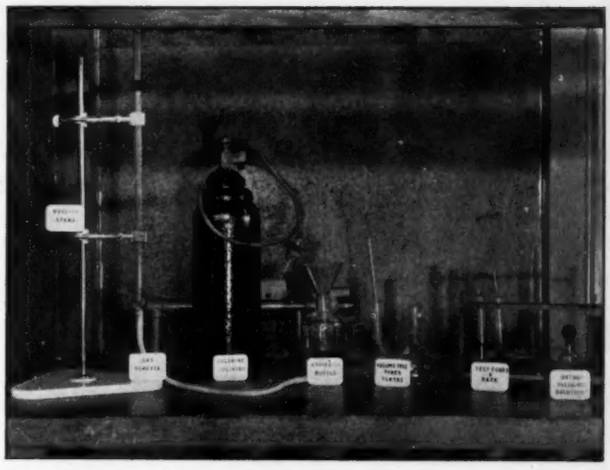
(5) A 1 cc. pipette; two ordinary test tubes, containing about 10 cc. of distilled water each, and supported in a small stand; a bottle of orthotolidine.

The total length of tubing used to connect the chlorine cylinder to the aspirator bottle should be 48 inches. This length is necessary to enable one to shake the bottle thoroughly, after the chlorine gas is introduced.

The Procedure

(1) Weigh out 1.195 grams of copperas and wash it carefully into the aspirator bottle by means of the funnel, with 200 cc. of distilled water from one of the volumetric flasks.

(2) The rubber stopper which is connected by the tubing to the chlorine cylinder, as above described, is moistened with a drop of water around the edge, and forced *tightly* into the neck of the bottle.



Laboratory Equipment Used in Routine Chlorinated-Copperas Production.

(3) Then very cautiously *crack* the valve on the chlorine cylinder until the level of the liquid in the burette has been forced up to the 36 cc. mark, when the chlorine should be stopped. The aspirator bottle should now be thoroughly shaken for at least one minute to absorb the chlorine.

To test the chlorinated-copperas (to see if enough chlorine has been introduced for complete oxidation) remove the stopper and by means of the pipette place one drop of the solution in the 10 cc. of distilled water in the test tube. Add two drops of ortho-tolidine solution. The solution should not show a yellow color the first time the test is made with only 36 cc. of chlorine having been used. Next add exactly 2 cc. more of chlorine and, after shaking the bottle thoroughly, repeat the test for oxidation. Usually from 38 to 39 cc. of chlorine is required when 1.195 grams of copperas is used.

Having introduced chlorine in small fractions (2 cc. each after the first negative test), it is possible to control the excess of chlorine very accurately and to prepare the solution of chlorinated-copperas day after day, with the same slight excess of chlorine desired. Without loss, the solution should be poured from the aspirator bottle into the reagent bottle. Rinse the burette and aspirator bottle three times with portions of distilled water from the remaining 200 cc. flask and add the balance to the reagent bottle to make the volume 400 cc.

The chlorinating procedure is best done under a hood, just in case there should be chlorine gas leakage.

If the chlorinated copperas is used in coagulation tests, run with a multiple stirrer, we find the above strength convenient. Added to 500 cc. of water, 1 cc. is equivalent to 50 pounds per million on the plant scale. This strength solution hydrolyses, however, within three hours. A stronger solution is much more stable and can be used over a longer period before it shows signs of clouding and losing coagulating value.

Credit is due H. E. Lordley, Plant Manager, for his assistance and his part in taking the photograph.

The Editor's Comments

America's "Bull Market" in Sewage Treatment

WHAT has been accomplished during the past two years in America, in the way of remedying pollution of its water-ways by treating city sewages is deserving of more than passing note.

When one stops to examine the progress made, and takes stock of that now under way to early completion, the numbers of the small and the larger communities provided with sewage treatment works becomes an impressive record. Plotting the available data, revealing the number of plants built or building, and the populations served by such plants, the rapid rise of the 3 year growth has the appearance of the rocketing stock market graphs of 1928 and 1929. We might say that there has been an unprecedented "Bull Market" in sewerage and sewage treatment in America, since the back of the depression was broken.

Taking the "population served" graph, it is evident that its spectacular rise has been due to the treatment works provided for such important cities as New York, Chicago, Cleveland, Buffalo, Detroit, St. Paul, Minneapolis, Los Angeles, San Francisco, Denver, Atlanta, Dayton, Columbus, Perth Amboy, Elizabeth and the Rahway Valley Project of New Jersey. (Conspicuous by its absence from this impressive list is Philadelphia.) Taking the "number of plants" graph, it is evident that the impressive rise has been due to the Rayne Louisiana's, the Yakima Washington's, the Christianburg Virginia's, the Leominster Massachusett's, the Sheboygan Wisconsin's, the Manville New Jersey's.

What brought on this "Bull Market" in sewerage betterments and sewage treatment? We do not believe that many would wish to claim that it was a reflection of a sudden awakening of public sentiment for cleaner streams. Unfortunately, the public awakening to a cleaner stream consciousness was the least cause of the flare for better sewage works and sewage treatment. What gave sewage treatment its lift in America was in reality the same thing that caused the depression depths to grow—unemployment and the desire of industry and local government to put men to work. More than the "desire" was needed however,—and the real cause of the notable progress in pollution abatement was the opportunity of the political subdivisions to get from a paternalistic Federal government much free aid in the shape of money for employment and materials.

What the two Federal agencies (P.W.A. and W.P.A.) contributed toward getting sewerage betterments long recommended, urged and prayed for by the State Health Departments, is now a matter of record which will live in history.

Nowhere is the history and record of accomplishments as the result of Federal aid, more adequately exemplified than that in the three densely populated river valleys of New Jersey. Telling of what has been accomplished in the systematic and comprehensive clean-up of domestic sewage pollution in the Elizabeth, the Rahway, and the Raritan Valleys on a basin-wide basis, Dr. Rudolfs, in this issue, unfolds "a story in three chapters" which challenges duplication. What he recites in the way of the long history of delays and excuses of communities for not being provided with sewage betterments, long urged by the state authorities; and then of the Federal aid which became available to stimulate a public demand (neatly worked up with the backing of industry) for a basin-wide clean-up; and the eventual outcome, in so brief a period, seemingly constitutes a new record in pollution abatement history.

No less impressive is the technical and systematic basis with which the requisite degree of treatment by the 13 various communities of the Raritan Valley was determined when taking the whole of the pollution load and available dilution of the basin's water-ways into consideration in setting up the basin project. The scheme involved planning and prosecution closely akin to those which one may picture as a pattern for Drainage Basin Authorities, advocated by many as the most practical method of equitably and effectively proceeding with stream cleansing. We should say that the Raritan Valley scheme is step number one in a program to an ultimate end. Step number two, as Dr. Rudolfs points out, must be taken later if stream cleansing is to be completed. That step involves alleviation of industrial pollution, which in toto is equivalent to, if not greater than, the domestic pollution load taken out in the first step.

In the Raritan Valley program it is especially interesting to observe the various types of modern treatment methods involved and the fullest permissible employment of combinations of primary and seasonal chemical treatment in eight of the thirteen plants to attain effects with economy. That New Jersey (with thanks to P.W.A. and W.P.A.) has done such an effective three valley job of cleaning up its streams is worth more than ordinary note of the sanitary engineering profession and appreciation of its citizenry. It is a glowing picture of what can be done in a highly industrialized area in which streams have long since been given up by an indifferent public.

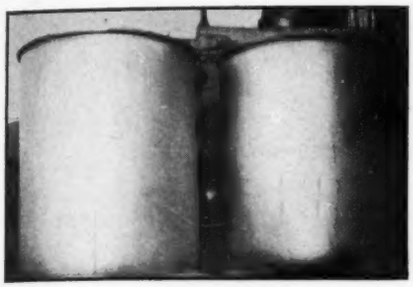
One can well afford to look at the accomplishments of a western state for another outstanding example of systematic progress in pollution abatement. The record of Wisconsin is impressive when we learn from statistics of growth in sewage treatment since 1935, and before. Not many realize that Wisconsin which boasted 120 sewage treatment plants on January 1st, 1935 (serving 983,638 people), by the end of 1937 had 168 plants—serving 1,339,924 people. Here was a gain of 48 plants, representing a 40% increase in the two years. More enlightening, perhaps, is the fact that the population served curve shows a concordant gain of better than 36%. What Wisconsin is accomplishing in its systematically prosecuted clean-up of Fox River pollution is akin to the developments in New Jersey's Raritan basin and the two serve as admirable examples of balanced techno-economic progress in pollution abatement, outstanding in American experience.

EQUIPMENT NEWS

Rubber-Lined Tank News

In December 1933 two rubber lined steel tanks of 12,000 gal. capacity each were installed at the Sewage Treatment Works of Dearborn, Mich., for the storage of concentrated ferric chloride solution. These tanks, together with three smaller service tanks, were lined in place with liquid (sprayed-on) Latex by the process of seamless rubber lining, developed by Collord, Inc., of Detroit, Mich.

Since there was at the time some question concerning the likelihood that the seamless lining might pull loose from the steel tank walls, or that blisters might form behind the linings, it is interesting to get a report from Fred R. Storrer, City Engineer of Dearborn, following a recent close inspection of the five tank interiors.



Dearborn's Rubber Lined Tanks

The report reveals that there has been no blistering or pulling away of the sprayed-on linings, after five years of use; nor has there been any hardening or other apparent deterioration of linings noted.

This inspection has fully supported the guarantees of the contractor—Collord, Inc. The material used was first grade compounded Latex, built up by spray application to 3/16th inch thickness, on all interior surfaces, including pipe, flanges and fittings.

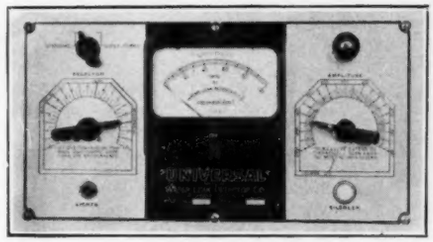
Engineers interested in rubber lining of tanks may find it profitable to look over the literature describing the Collord S. R. L. Process. Write Collord, Inc., 7049 Lynden Ave., Detroit, Mich.

▼

Improved Leak Detector Features Super-Power for Deep and Distant Leaks

Water Leak Detector Co. of Columbus, Ohio, have recently announced an improved 1938 model "Universal" Water Leak Detector which features "Super-Power" for the purpose of increased certainty of locating leaks at greater depth of pipe, under thicker paving or sidewalks, and at distances heretofore beyond accurate detection with earlier models.

The uncanny "Universal" converts water jet vibrations of hidden leaks into measured sound waves, through its compact radio frequency and amplification equipment. The improved 1938 model has more than sound detection, which unfortunately



1938 *Model "Universal" Water Leak Detector*

depends upon the human ear to evaluate; it has an element for converting sound waves into light waves which dance across a small etched glass screen, to produce "visible" leak detection. Thus is eliminated the personal equation of operators in evaluating sound effects when tuning the instrument to eliminate traffic vibrations.

Another feature of the 1938 model "Universal" is that the B battery pack has been eliminated due to the new automatic built in converter. It is Spring and, symbolic of the season, the improved "Universal" appears in the new "dress," here illustrated. The new panel of Aluminite, with red and black markings on the silver ground, improves its appearance and, likewise, visibility of dial gradations.

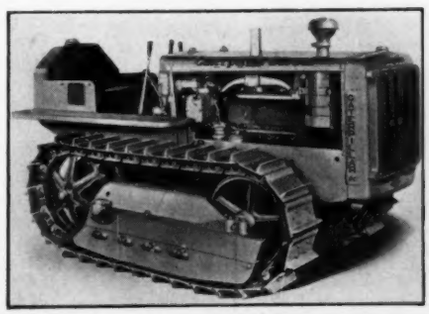
New filter construction on the new Converter Type Super Power "Universal" is said to effectively reduce traffic noise and other interfering vibrations to a minimum. It is reported that smaller, deeper and more distant leaks have been located with the improved "Universal" than have ever before been possible of location with any instrument. To more effectively penetrate thick paving in noisy districts was the "necessity" which proved to be Super Power Universal's "mother of invention."

New catalog literature describes, pictures and tells the how and why in operating 1938's "Universal." For a copy of "Super Power (Converter Type) Universal" write Water Leak Detector Co., 155 No. Third St., Columbus, Ohio.

▼

Small Utility Type Caterpillar Is Diesel Powered

Caterpillar Tractor Co. has just announced their new track type D-2 "Caterpillar" which is Diesel powered but yet small enough for general utility use under a variety of conditions at low cost operation.



New Type D-2 "Caterpillar Tractor" .

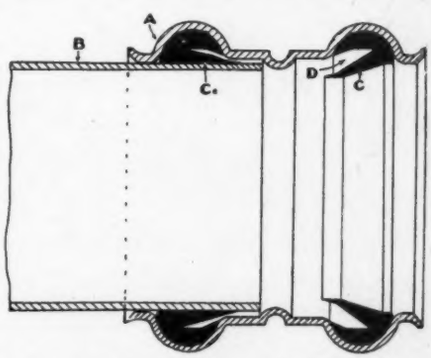
The small utilitarian "Caterpillar" can be used for anything from pulling plows, to grading work, handling pipe and fittings in stock yards or on the job, to trench filling. For general utility in Water and Sewage Departments, as well as for contractors, it would seem to have considerable appeal as a practical size economically operated flexible machine. We have recently known of a similar crane equipped machine being effectively used to handle pipes, fittings, et. al. in stock yards of a water company.

As to economy of operation, over spark ignited machines, working under average conditions at 1¼ gals. of fuel oil per hour, fuel costs have been reported cut 60 to 80 percent. For literature, describing the interesting D-2 Caterpillar, write Caterpillar Tractor Co., Peoria, Ill.

▼

Pipe Couplings Without Threads or Bolts

The R. H. Pierce Mfg. Co. of Eugene, Oregon are offering an ingenious Self-Sealing Pipe Coupling which makes use of the pressure of the liquid within the pipe to produce leak-less sealing of the joint. Pierce's coupling, as the illustration



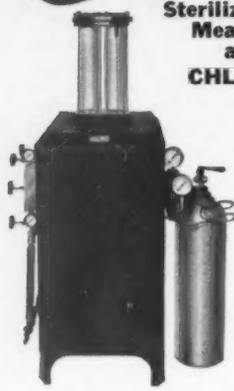
Cross Section of Coupler with One Pipe in Place.

reveals, has neither threads nor bolts. Its construction is of a single piece of steel tubing (A) cold rolled into shape. Within are two cup-rubber gaskets—(C) and (Cc). In making the joint the coupling is trust onto the plain end pipe up to the bead, as shown above. The next pipe is shoved into the other end of the coupling, thus forcing the gasket flap (C) into position shown at (Cc). The broad flat area of the gasket with the pipe line pressure back of it, compressing it on the pipe surface, does the sealing. Theoretically, at least, the higher the pressure the tighter the seal.

With these novel couplings the manufacturer claims that the joint can be easily taken apart and reassembled as frequently as necessary, a feature making the Self-Sealing Coupling especially interesting for

Everson

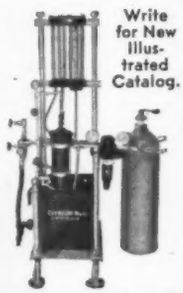
Sterilizing Apparatus Measures, Mixes and Feeds CHLORINE GAS



Accurate, Dependable, Safe! Finger tip control. All sizes with 1 to 10 capacity ratio —maximum 10 times minimum.

A complete line for Water Works, Sewage Plants and Swimming Pools with new Rota-Meter Gas Flow Control. New low prices all the way. Cabinet, Panel and Standard Models — so inexpensive that no job can afford to be without an extra "stand-by" unit.

Write for New Illustrated Catalog.



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Root troubles in sewers can be eliminated by the use of Copper Sulphate. Cities and towns have used copper sulphate for this purpose for several years. By throwing the copper sulphate crystals into choked sewers, while at least some sewage is still flowing, a sufficient concentration of the poison kills the "feeder" stem and the root mass breaks the dead stem which has lost its toughness. Down the sewer go the root balls to its outlet.

WE INVITE YOUR INQUIRIES

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22 E. 40th St. New York

use on movable or temporary pipe lines, or those subject to relocation from time to time, such as irrigation and oil or gas lines.

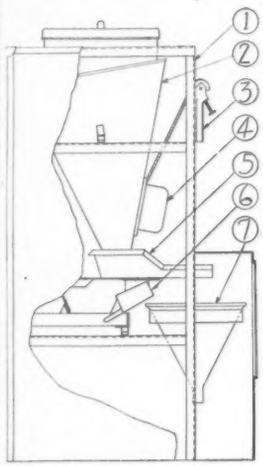
Pierce's Self-Sealing Couplings are available for pipe sizes of 1 in. to 20 inches inside diameter—weigh from 1 to 30 lbs. each. For descriptive folders and price list, write The R. H. Pierce Mfg. Co., 245 Blair St., Eugene, Oregon.

▼

Cabinet Model Dry Feeder Machine

Syntron Co., Homer City, Pa., have just brought out a new model of the Syntron Dry Chemical Feeder in a fully enclosed, dust tight, metal cabinet finished in ivory colored enamel and polished aluminum.

The new model has the well known Syntron "Vibra-Flow" Feeder Conveyor. This is a trough which, mounted on leaf springs and reciprocated by a small electro-magnet, flows dry chemicals by vibration from the feed trough. The chemical spills from the trough into the vortex solution pot. The rate of flow is controlled by varying the current to the trough's electro-magnet through a rheostat. The latter, with the calibrated feed indicating meter, is mounted in the control panel on one side of the machine.



DETAILS
1. Frame.
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3. Hopper Adjustment.
4. Hopper Vibrator.
5. "Vibra-Flow" Feeder
6. "Vibra-Flow" Magnet.
7. Solution Pot.*

New Model Syntron Dry Chemical Feeder

The built-in hopper is equipped with a small, noiseless, electro-magnet vibrator that keeps the contents agitated and free flowing. Capacity ranges up to 100 lbs. per hour for light fluffy material, such as activated carbon, to as much as 800 lbs. per hour of heavy material, such as alum, soda ash, etc.

A new catalog sheet has been issued on the Cabinet Model Feeder. For a copy address Syntron Co., 650 Lexington Ave., Homer City, Pa.

▼

WITH THE MANUFACTURERS

Mr. "A" Alum Has "Gone to Town"

In recent publicity, Activated Alum Corporation of Baltimore, Md., used the catchy phraseology Mr. "A." Alum and Mr. "B." Alum *"Go to Town!"*

Recent information seems to indicate that Mr. "A" Alum has really *"Gone to Town!"* —and, a big town at that. Not long ago we heard that this youngest of the alum producers had placed its "Standard" Activated Alum, and its novel "Black Alum," in 14 states. Later a list of 21 important cities using Activated Alum's coagulants were shown—the largest being Trenton, N. J. This week, news has come that Mr. "A" Alum has "sho-nuff gone to town" in a big way. In short "little" Activated has been awarded its biggest contract for Standard Activated Alum—no less than the entire year's supply for Cleveland, Ohio.

When this happened it was a red-letter day (and a deserved one) in a young executive's life—that of Fred Stuart, former water works operator who "came to town" to put "Nuchar" into thousands of water plants and, now, heads his own company—Activated Alum Corp.—with a new plant in Baltimore, Md., and offices in New York City.

▼

Bailey Meter Co. Appoints Nine "Cadet" Engineers for 1938

Bailey Meter Co. of Cleveland, Ohio, following its policy of giving young engineers training and experience in the district offices of the company, announce the appointment of the following nine "Cadet Engineers" to the several offices.

Paul Davenport (Penn State) to Philadelphia.

H. E. Eleniewski (Lafayette) to Buffalo.

O. L. Garretson (Iowa State) to St. Louis.

H. R. Kroeger (Ohio State) to Denver.

F. M. LeCompte (Alabama) to New York.

H. R. Lenthy (Case School) to Chicago.

T. O. Thompson (Missouri) to Houston.

P. H. Vernor (Purdue) to Milwaukee.

J. H. Dennis (Penn State) to Pittsburgh.

Bailey's "Cadet Engineers" are chosen from various colleges and universities on the basis of their records with respect to scholastic work, student activities and personality. Amongst the 150 graduate engineers, now in the company's employ, approximately 50 different colleges and universities in the U. S. and Canada are already represented by "graduates" from Bailey Meters' "Cadet" Engineering Courses.

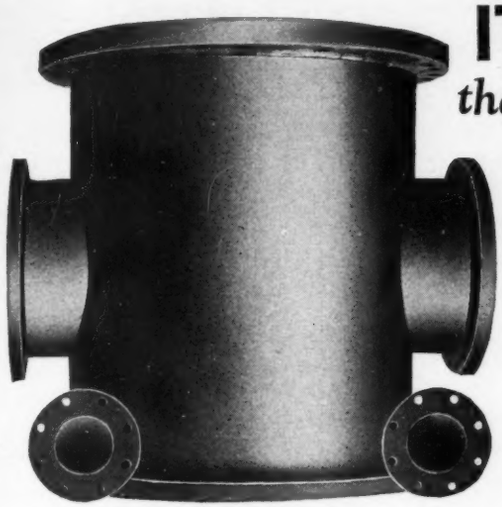
▼

Worthington Appoints W. A. Meiter Manager of Buffalo Office

Worthington Pump and Machinery Corpn. announces the appointment of W. A. Meiter to the position of Manager of its Buffalo sales office.

Mr. Meiter has been a member of the Worthington organization since his graduation from Ohio State University in 1927, and has served the major portion of his time as a salesman in the Cleveland territory. Mr. Meiter succeeds Mr. C. C. Scott, who will not devote his entire time to special work in the Buffalo district.

LFC



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Bell and Spigot Pipe and Fittings. From 4" to 54".
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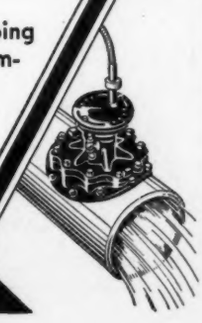
Where uniform accuracy is demanded, you will find SPARLING Main-Line Meters on the job. Accuracy is built-in by perfect machining of every part, rigid inspection of assembly and thorough testing of the completed instruments. That is why their initial accuracy lasts through many long years of service. Interchangeable parts prolong their life indefinitely.

In sizes from two to sixty inch, they meet all master metering requirements of the smallest plant to the largest municipal water system.

Moderately priced, low in maintenance cost, easy to install.

Send for Bulletin 304, fully describing Sparling Main-line Meters and companion Indicators and Recorders.



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The Pomona policy of constantly insisting on the use of the best methods and materials, with precision workmanship, has been abundantly protective and profitable to owners of Pomona Pumps. It has built a substantial organization with every facility for continual accuracy. It has made the name "Pomona" a guaranty of economy and satisfaction to engineers who use Pomona Pumps.

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POMONA TURBINE PUMPS

KENNISON OPEN FLOW NOZZLE

Kennison Nozzle (Patented)—10-inch size.

A simple, accurate means of metering raw sewage and industrial wastes.

The Kennison Open Flow Nozzle (patented) furnishes for sewerage systems an entirely new method of measuring flow in pipes flowing partially full with wide variation in rate.

A single float serves to actuate a nearby standard Register-Indicator-Recorder. The readings can be transmitted to a distant point, if desired.

The Kennison Nozzle should be found broadly applicable to the numerous flow metering problems under low heads in main system and in the disposal plant.

Write for new descriptive Bulletin 289 which gives detailed dimensions and capacities.

Laboratory Calibration Test of Kennison Nozzle

BUILDERS IRON FOUNDRY

"Builders of the Venturi Since 1891"

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MEETINGS SCHEDULED:

Mar. 17—BOSTON, MASS. (Hotel Statler).
New England Water Works Association. (Monthly Meeting.) Sec'y, Frank J. Gifford, 613 Statler Bldg., Boston. Mass.

Mar. 21-23—LOUISVILLE, KY. (Brown Hotel).
Kentucky-Tenn. Section A.W.W.A. Sec'y, H. D. Schmidt, State Dept. Health, Nashville, Tenn.

Mar. 23-25—WINDSOR. ONTARIO (Prince Edward Hotel).
Canadian Section A.W.W.A. (Annual Meeting). Sec'y, Treas., A. E. Berry, Ontario Dept. Health, Parliament Bldgs., Toronto, Ont.

Mar. 24-26—LAWRENCE, KANS. (University of Kansas).
Kansas Water & Sewage Works Association. Sec'y-Treas., Earnest Boyce, Chief Engr., State Dept. of Health, Lawrence, Kans. (Preceding the Association meeting the Annual Water & Sewage Short School is scheduled at the University for March 21, 22 and 23rd.)

March 25—FREEPORT, L. I.
Long Island Section, N. Y. S. S. W. A. Freeport Sewage Treatment Plant (3:30 p. m.). Dinner South Shore Yacht Club. Sec'y, Lawrence J. Luther, Municipal Bldg., Freeport, L. I., N. Y.

Mar. 28-30—FAYETTEVILLE, ARK. (University of Arkansas).
Arkansas Water and Sewage Works Conference. Sec'y, Harrison Hale, University of Arkansas. Fayetteville, Ark.

Mar. 30-Apr. 1—EAST LANSING, MICH. (Michigan State College).
Michigan Sewage Works Operators' Conference. Sec'y, W. F. Shephard, Asst. Engr., State Dept. of Health, Lansing, Mich. (Preceding the Conference the Annual Short Course for Sewage Works Operators will be held at Michigan State College, March 28, 29 and 30.)

Apr. 5-6—DECATUR, ILL. (Orlando Hotel).
Illinois Section A.W.W.A. Sec'y, Mr. Winfred D. Gerber, P. O. Box 232, Urbana, Ill.

Apr. 7-8—LAFAYETTE, IND. (Purdue University).
Indiana Section A.W.W.A. (Annual Meeting). Sec'y, Treas., John A. Bruhn, Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.

Apr. 11-12—SAN DIEGO, CALIF. (U. S. Grant Hotel).
California Sewage Works Association. Sec'y-Treas., R. R. Ribal, 701 City Hall, Oakland, Calif.

Apr. 14—BRISTOL, CONN. (New Departure Inn).
New England Water Works Association. (Spring Meeting.) Sec'y, Frank J. Gifford, 613 Statler Bldg., Boston, Mass.

Apr. 20-23—JACKSONVILLE, FLA.
American Society Civil Engineers. (Spring Meeting). Sec'y, Geo. T. Seabury, 33 W. 39th St., New York City.

Apr. 24-28—NEW ORLEANS, LA. (Hotel Roosevelt).
American Water Works Association (Annual Convention). Executive-Secretary, H. E. Jordan, 22 East 40th St., New York City, N. Y.

May 9—DANBURY, CONN. (Hotel Green).
New England Sewage Works Association. (Spring Meeting). Sec'y, F. W. Gilcreas, State Dept. of Health, Albany, N. Y.

May 13-14—BOZEMAN, MONT. (Baxter Hotel).
Montana Section A.W.W.A. Sec'y, H. B. Foote, State Board of Health, Helena, Mont.

May 19-20—BALTIMORE, MD. (Hotel Emerson).
Maryland-Delaware Water & Sewage Works Assn. Sec'y, A. W. Blohm, Asst. Engr., State Dept. of Health, Baltimore, Md.

May 19-21—SPOKANE, WASH. (Hotel Davenport).
Pacific Northwest Section A.W.W.A. Sec'y, Fred Merryfield, Oregon State College, Corvallis, Ore.

May 23-25—DAYTONA BEACH, FLA. (Williams Hotel).
Florida Section A.W.W.A. Sec'y, J. R. Hoy, 404 Hildebrandt Bldg., Jacksonville, Fla.

May 25—NEW MILFORD, N. J. (Hackensack Water Co. Plant).
New Jersey Section A.W.W.A. Sec'y, Prof. H. N. Lendall, College of Engineering, Rutgers University, New Brunswick, N. J.

Sept. 13-16—BOSTON, MASS. (Hotel Statler).
New England Water Works Association. (57th Annual Convention). Sec'y, Frank J. Gifford, 613 Statler Bldg., Boston, Mass.

CATALOGS AND LITERATURE RECEIVED

[Any of the publications reviewed in this section can be secured from or through Water Works and Sewerage, if such be desirable.]

"Circuline" Sludge and Scum Collectors—Are lucidly described and effectively picturized, in general views and in close-ups of important details, in Link-Belt Company's new 24 page brochure which is pleasing to the eye, interesting to review. The "Circuline" Collector was designed for circular tanks to incorporate features of Link-Belt positive acting "Straightline" Sludge Collectors and Scum Sweeps with the revolving bridge mechanism suitable for round tanks. Thereby, the manufacturer boasts the "Circuline" Collector to possess the operating advantages of its "Straightline" Collector (long used for rectangular tanks for positive sludge and scum removal) with the economy of construction of round tanks, and the operating advantages and desirable hydraulics of center feed and peripheral take-off. An interesting feature of the "Circuline" is the deep plate-sealed central sludge pocket of annular pattern. The seal-plate (cover) largely prevents overlying liquid from breaking through the thickened sludge when withdrawing solids from the tank. Other features are the slow travel of collector and skimming mechanism, which the manufacturer states to be permissible because one revolution completely clears the surface of scum and the floor of sludge. The brochure is a worthy production for the details easily seen and read. In the rear are detailed plans and design tables helpful to engineers.

"Circuline" Collector Book No. 1642 can be had from Link-Belt Co., 300 W. Pershing Rd., Chicago; or 2045 W. Hunting Park Ave., Phila., Pa.

"Turbine Pump Drive by Johnson"—The increasing practice of providing auxiliary, if not continuous, right-angle drive of deep well turbines through gear heads connected by shafting or belting to a gas or oil engine, lends special interest to the new bulletin from Johnson Gear and Mfg. Co. (Established 1906) of Berkeley, Calif. The Johnson Right-Angle Gear Drive is described with respect to its features of technical correctness (based on long experience in the well fields) and soundness of economy in employing right-angle drive or a combination of such with the usual motor drive head. The new bulletin points out the various factors and design features which makes it possible to boast guarantees of 95 per cent efficiency from the Johnson Right-Angle Gear Drive—positive, cool, efficient, "controlled" lubrication being not the least. Several typical installations are pictured, which with drawings and tables of dimensions, are interesting and helpful. For Catalog No. 10, write Johnson Gear and Mfg. Co. (Ltd.), 8th and Parker Sts., Berkeley, Calif.

"Brassert's Automatic Strainers"—In our September 1937 issue (Equipment News Section) we carried a rather complete description of design and operating features of the new Brassert Automatic Strainer. In a recent mailing a new folder has been received which effectively pictures and describes this unique device for insertion in pipe lines for straining suspended solids from water, trade wastes or sewage. It operates continuously on the principle of an enclosed self-cleansing

Automatic Magnetite Filters for Clearer Effluents; Conkey Vacuum Filters for Sanitary Sludge Disposal, Meet These Varied Plant Requirements.

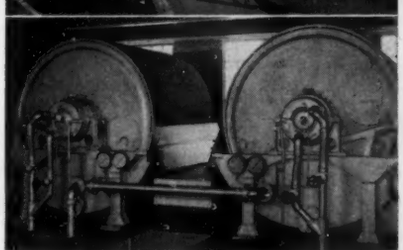
Minneapolis - St. Paul — Sanitary District.
8—16′ x 245′ downflow Magnetite Filters—for straining both plain settled and chemically treated effluent. C. C. Wilbur, Chief Engineer; George J. Schroepfer, Assistant Chief Engineer; W. N. Carey, P.W.A. Project Engineer.

Cleveland, Ohio. Southerly Plant.
3—16′ x 229′ downflow Magnetite Filters—for straining trickling filter effluent. Consulting Engineers, Gascoigne & Associates, New York and Cleveland.

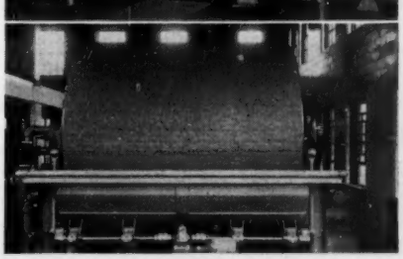
Denver, Colorado.
6—12′ x 200′ downflow Magnetite Filters now in operation for straining both plain settled and chemically treated effluent. Consulting Engineers, Black and Veatch, Kansas City.

Atlanta, Georgia, Intrenchment Creek Plant.
12′ upflow Magnetite Filter now in operation on 100′ diameter tank for filtering effluent from trickling filter. Consulting Engineers, Wiedeman and Singleton, Atlanta.

Elmira, New York.
2—8′ wide upflow Magnetite Filters in operation on 60′ diameter tanks for straining plain settled and chemically precipitated effluent. Consulting Engineers, Remington and Goff, Camden, N. J.



Neenah-Menasha, Wisconsin.
2 Conkey Rotary Vacuum Filters now operating for dewatering plain settled or digested sludge from domestic and paper mill wastes. Consulting Engineers, Greeley and Hansen, Chicago, Ill.



Auburn, N. Y.
One of the 2 Conkey Rotary Vacuum Filters now operating on plain settled and chemically treated sludge. Thomas Bowe, Consulting Engineer.

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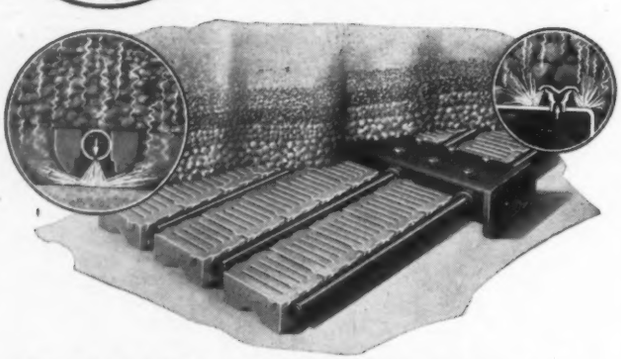

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strainer. It is compact and has a multitude of easily replaceable porcelain discs through which the strainer holes extend. These strainer discs which come with variable size holes are located in the revolving cone shaped cylinder. Sectional wash occurs as the cone revolves at the speed found best for the job at hand. For a more effective description, look up that in our September issue—better still, request "Brassert Automatic Strainers" from H. A. Brassert & Co., 310 S. Michigan Ave., Chicago.

"H-O-H Lighthouse"—Is the house organ (and more) issued bimonthly by D. W. Haering & Co. of Chicago—chemical and feeding equipment manufacturers who offer water treatment service to industries, and specialize in scale and corrosion control compounds and treatments. The 1938 "H-O-H Lighthouse" has an improved format and a more striking front cover. Starting in the last (Feby.) issue is a series of articles dealing with water quality problems and water requirements of various industries. Also there is a section devoted to "News of the Field." To anyone interested in scale and corrosion control Haering's "Lighthouse" will be worth reading. It is being distributed free to those who request that their names be placed on the mailing list. Address D. W. Haering & Co. (Inc.), 3408 Monroe St., Chicago.

"Parker Tube Couplings"—These and other Parker water service fittings are presented in a folder from Parker Appliance Co. of Cleveland, who specialize in union type brass coupling in which the ends of the copper tubing are flared (belled out with a flaring tool) to fit the compression seats of the coupling. No soldering or threading is involved. Long known in the automobile and industrial field for tightness, Parker flared fittings are even being successfully employed on copper tubing lines carrying liquid chlorine and chlorine gas under pressure. The soft flared-end copper tubing when under compression is an excellent one. The fitting "seat," being machined to true bevel, makes a water and gas tight joint with ease. For Parker's Bulletin No. 33 showing the complete line of water, sewage and gas or air line fittings, write Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio.

"Motors—Their Selection and Maintenance"—Westinghouse has recently published a 12 page brochure which gives pointers in the proper selection of electric motors, with illustrations to enhance the value of the discussion. Charts are employed to guide the reader, but particularly is the material prepared for the operator who may not be technically trained. Selection of circuit, protection and control equipment, are also covered. The section devoted to "maintenance" offers 10 worthy "hints" in effective and money saving maintenance practices as applied to motors and control equipment. Copies of "Electric Drive Selector—With Hints on Maintenance" may be had from Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

"Water—Oceans of It!"—Is the newest Crane folder which, attractively illustrated, emphasizes the dependence which is placed upon valves and sluice gates in water works and sewerage operations. The question raised in the folder is—"What's behind your valves and gates?" It also serves to announce the newest Crane Equipment Catalog—"Crane Water and Sewage Control Equipment." For a copy of the latter write Crane Co., 836 S. Michigan, Chicago.

"Morris Straightflo Pumps"—Are described in a recent bulletin from Morris Machine Works—73 year old pioneering builders of centrifugal pumps. The

"Straightflo" is an irrigation type (low head large volume) pump, with improvements to raise efficiencies and performance characteristics of such pumps, so serviceable in handling trash laden waters, crude sewages, etc. Involved is a specially formed casing "fitted" with an open screw type impeller, driven by vertical or horizontal shafting with ordinary high-speed motors. The bulletin describes these utilitarian pumps in illustrated detail, and presents rating tables which show performances under various heads up to 40 ft. and volumes above 1,500 g.p.m. For Bul. No. 167, write Morris Machine Works, Baldwinsville, N. Y.

"Omega Precision Solution Feeders" — From Omega, of Kansas City, has come a 4 page catalog-insert, which describes and illustrates the recently improved Omega Precision Feeders for liquids and suspensions. These solution feeders are increasingly seen in water and sewage plants where the chemical requirement is relatively low. Also the larger works, where liquid ferric-chloride is employed in coagulation or in the dewatering of sludges at sewage treatment plants. The recent Cleveland installations, where Omega full automatic solution feed is provided, are stressed. For the new catalog pages write Omega Machine Co., Kansas City, Mo.

"Controlling Valves Electrically"—Is the caption on a miniature illustrated text-book which has just been issued by Automatic Switch Co., manufacturers of a variety of Automatic Solenoid valves. The topics treated are: The Problem; What Can Be Controlled; Use of Pilot Control; Choosing the Proper Valve; Why ASCO Solenoid Valves? For a copy of this "Two-Minute Reader" write Automatic Switch Co., 154 Grand St., New York City.

"Woven Glass Filter Cloth"—One of the developments around which interest of chemical-engineers is centering is the spinning of fibers from molten glass. In turn these fibers go into spun thread, or light cords, to be braided into ropes or woven into "Glass Fiber Cloth." The glass cloth looks like silk, feels like asbestos cloth, resists corrosion like the silica of which it is made. Notwithstanding its novel position and introductory cost and, therefore, the high first cost in equipping vacuum-filters with a filter cloth of maximum resistance to corrosion spun glass cloth bids fair to enjoy a bright future. The idea was born in 1932 in the Owens-Illinois Glass Company's laboratories. In 1935 100 per cent glass filter cloth became a reality; in 1937 it went into commercial production. It functions like wool, or cotton, or woven metal cloths; and, is readily cut and fitted. It is *permanent*. An interesting descriptive bulletin and a sample of "Fiberglas Filter Media" may be had from the pioneering producers—Filter Media Corporation, Irvington-on-Hudson, New York.

"Simplex Aerators"—Are described in a new bulletin devoted to details concerning mechanical features of Simplex Sewerage Aerators for activated sludge treatment by mechanical aeration. A partial listing of the more than 200 units of this one make that are in operation in America indicates the extent to which mechanical aeration has been adopted for medium and small works. Operating data (performance) and power consumed are tabulated for a few important installations pictured. For a copy of Bul. A-13-37, write Simplex Ejector and Aerator Corp., 2400 W. Madison St., Chicago, Ill.

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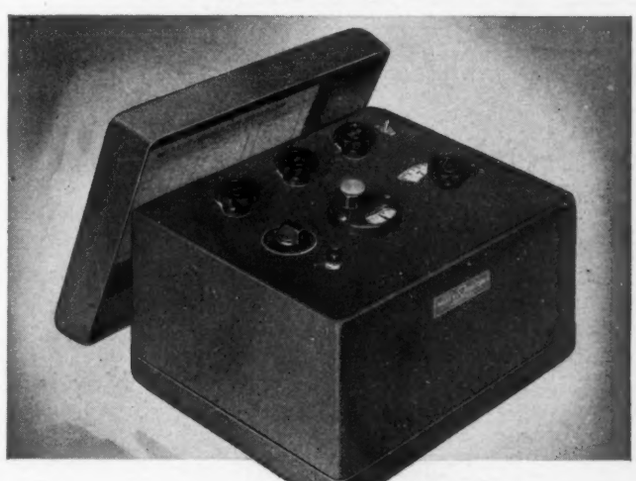

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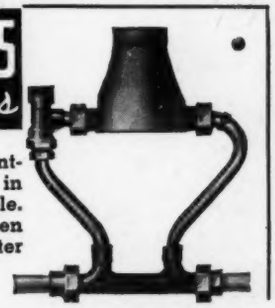

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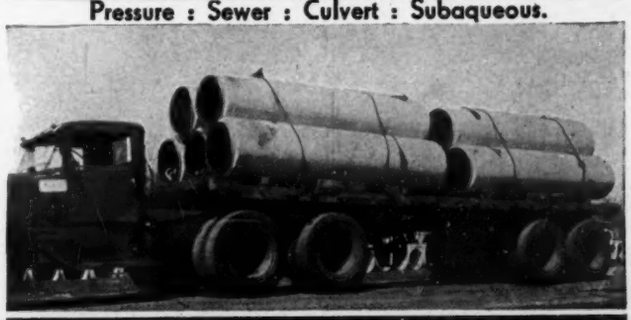

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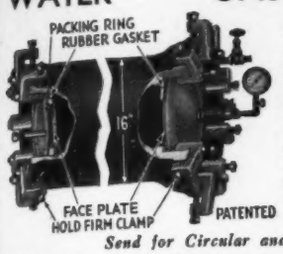

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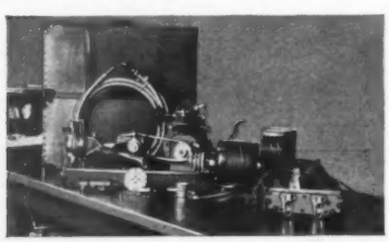

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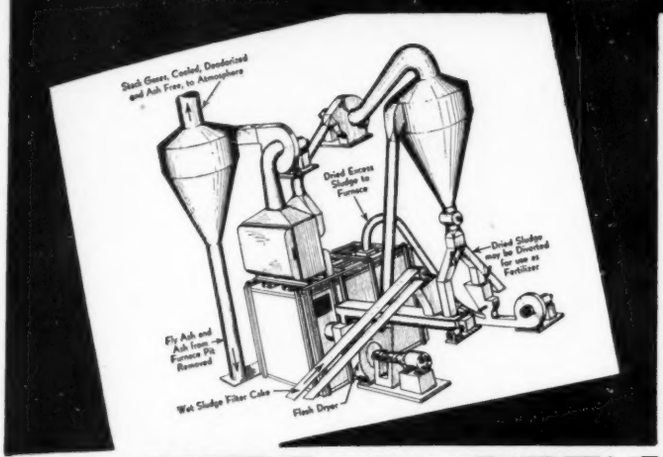
AT NEENAH-MENASHA, WISC.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Wet Sludge Filter Cake
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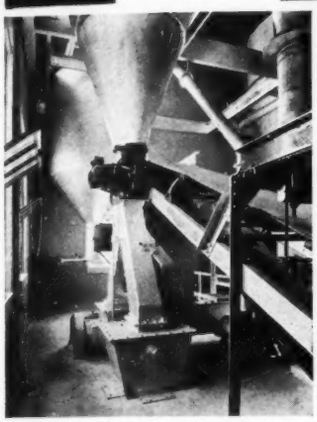
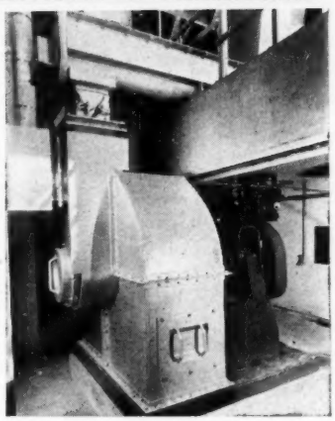
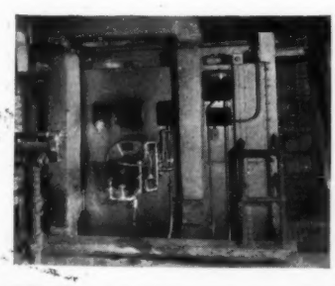
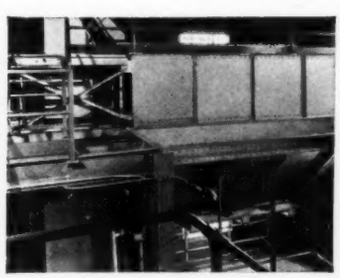




FEED CONDITIONING (Left)—Filter cake at 70 per cent moisture is conveyed by belt to the Mixer, to be mixed with dried sludge before introduction into the C-E Raymond System.

FLASH DRYING (Right)—Filter cake, mixed with dried sludge, is fed by a screw conveyor to the Flash Drier, heated by hot gases from the furnace.





SEWAGE SOLIDS from the two cities of Neenah and Menasha, Wisconsin, are disposed of after vacuum filtration in this C-E Raymond System. Sewage flow to the treatment plant is 8 M.G.D., equivalent to 21,000 to 33,000 lbs. of dry solids per day.

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●

INCINERATION (Left)—The furnace has an auxiliary fuel oil burner. Only 5/8 gals. of oil are required per hour when the dried sludge contains 4000-4500 B.T.U. per pound, and combustion becomes almost self supporting.

ASH STORAGE (Right)—Ash, in powdered, clinker-free form, is elevated to bottom—discharge bins—3 days capacity—and discharged to trucks. It is now being used for filling low ground around the plant.

● Inquiries regarding the use of the C-E Raymond System in the sanitary engineering field should be directed to the nearest Dorr Company office.

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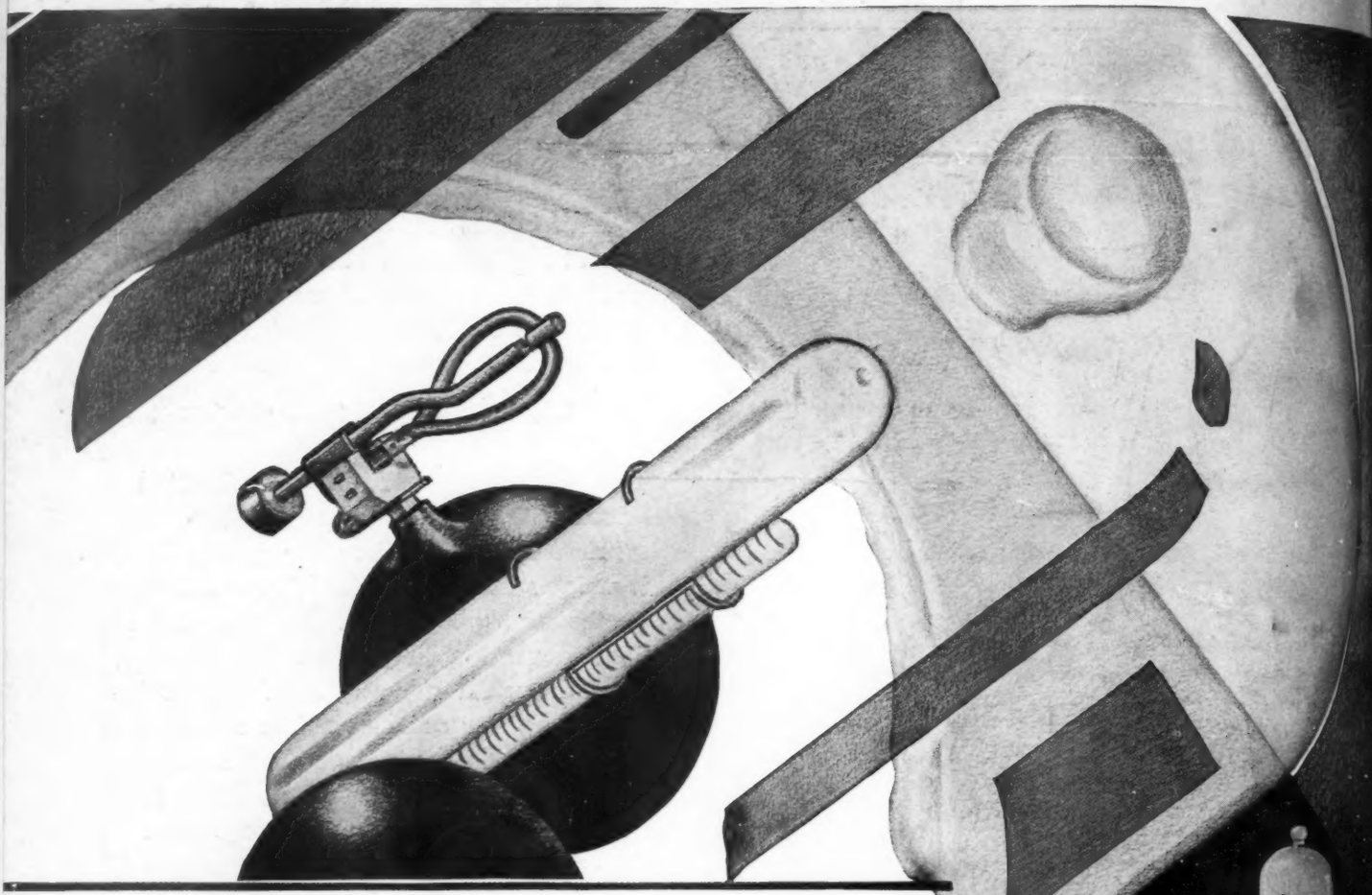

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Ask for technical publications 38, 157 and 158 describing W&T Visible Vacuum Chlorinators.

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